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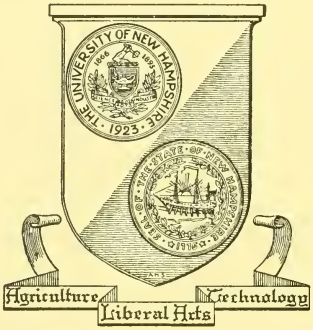

The University
of
New Hampshire

Effects of Flood Control Projects on Agriculture

I. Reservoir Areas

By

GEORGE B. ROGERS

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Summary

1. The alluvial river bottoms of New Hampshire provide the essential productive land base for a large part of the state's more successful commercial farms.

2. Industrial, recreational, and residential development, and the building of highways, airports, and other public facilities have made heavy encroachments on the limited good farmland of the state.

3. Flood control reservoirs, built mainly for the protection of downstream urban developments, may make further heavy inroads on the state's farmlands.

4. Despite the displacement of farm buildings from reservoir areas and greater distances separating these lands from farmsteads, reservoir lands can contribute a material agricultural output under proper public-private cooperative arrangements.

5. The risks of using reservoir lands are probably over-exaggerated, although certain lands become much more subject to flooding during the growing season after construction of such projects.

6. A declining demand for farmland, lack of information on the real risks involved in using reservoir lands, the acquisition and leasing practices existing, and the lack of a more positive land management policy have all contributed to a decline in agricultural output from reservoir areas since project construction.

7. This report appraises some of the effects of flood control projects on agriculture and examines the potential values attainable from such lands under improved management practices. It is hoped that these findings will be given careful consideration by appropriate agencies with the view of minimizing adverse effects of these and future projects.

Effects of Flood Control Projects on Agriculture

I. Reservoir Areas

By George B. Rogers, Research Economist

1. Introduction

FUTURE construction of flood control dams is planned in New Hampshire and other states of the Northeast. The acquisition of lands for dam and reservoir sites poses numerous problems for farm operators, rural communities, and participating agencies of government. Full or part-time farms may lose buildings and land, resulting in curtailment or disruption of operations or complete displacement from the area. Even with adequate compensation for property, the costs of disruption and moving are likely to be substantial and probably not fully reflected in monetary settlements. The loss of forest and woodland may mean the disappearance of some employment opportunities for local people and the loss of potential income to persons holding such properties for speculative gain. Towns may have to relocate or build new schools, roads, and other public facilities. There may be potential loss of revenue to the town, not only on acquired properties, but because of adverse economic effects from loss of population. Participating agencies of government assume a major public relations problem relative to acquisition and settlement through negotiation or legal action. In addition, they assume responsibility for proper management of reservoir lands during and after construction. This may involve leasing and measures to maintain productive capacity for lands kept in agricultural use and determination of alternative uses.

Four flood control projects have been completed in New Hampshire to date. These are at Franklin Falls on the Pemigewasset River, at Webster on the Blackwater River, at West Peterborough on Nubansit Brook, and at Surry Mountain on the Ashuelot River. A number of additional projects are in planning or discussion stages as part of the comprehensive flood control plans for the Merrimack and Connecticut River basins. (Figure 1.)

The New Hampshire Agricultural Experiment Station, in cooperation with the United States Department of Agriculture, undertook in 1954 a study of the effects of existing dams and reservoirs on agriculture, both in the reservoir and downstream areas. This report, prepared by the N. H. Station in 1955, is designed to appraise the effects in the reservoir areas. Perhaps experience gained from the existing projects can indicate measures to improve relationships and practices relative to these projects, and also to minimize the impacts of future projects on farms and communities.

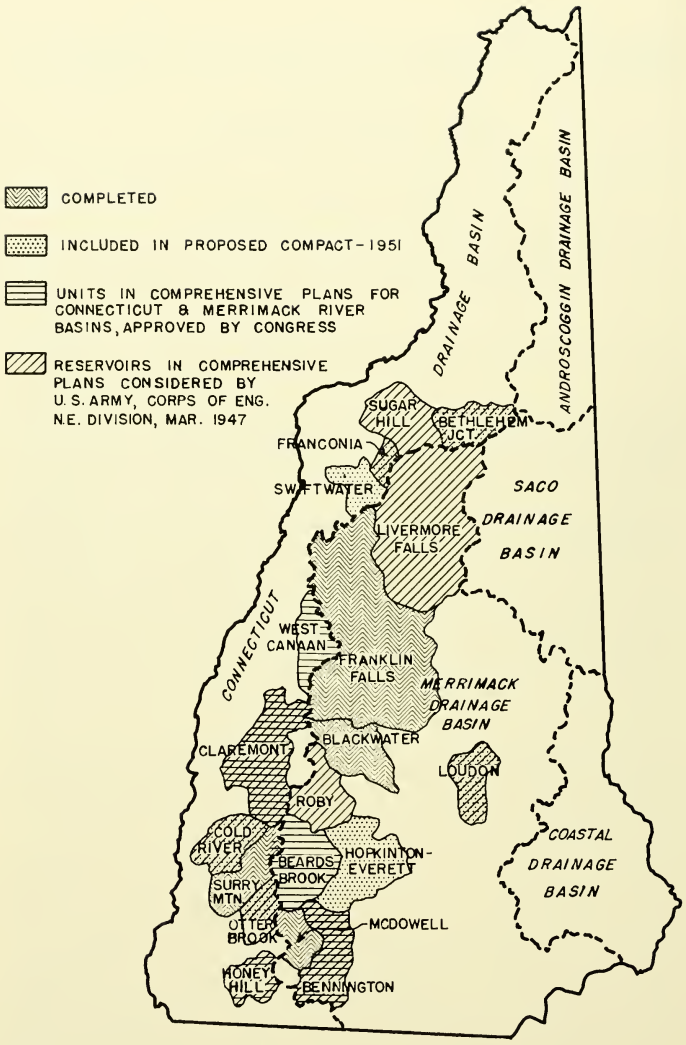
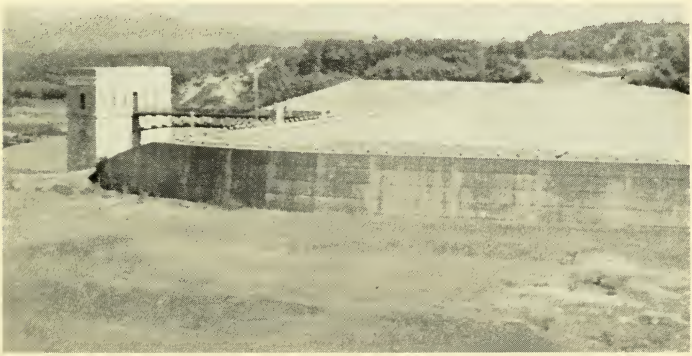


Figure 1. A flood control reservoir plan for New Hampshire. Source: "New Hampshire Water", New Hampshire State Planning and Development Commission, Concord, 1953, p. 2.

The chief benefits from flood control projects in most areas of the Northeast are likely to accrue from prevention of damage to downstream industrial, residential, and recreational properties. These may be greater than the prevention of downstream damages to farm buildings, land, livestock, fences, and equipment. However, within dam-site and reservoir areas, a principal adverse effect on local economies may be the loss of farms. While the site choice will influence this effect, with most large projects the short-run displacement of invested capital in farms producing for sale and home use may be the largest single type of loss. Residential and business properties may represent a greater total current investment than farms, but their removal from the site might not have as great a permanent effect on the local economy as the loss of farms. Other locations in the area may be available for the establishment of new domiciles and places of business, but the productive farm resources in the area are likely to be more limited.



Franklin Falls dam and area leading to spillway as seen from Route 3A, West Franklin, N. H.

These considerations give rise to some basic questions with which future legislative and action programs must cope. For example, shall we build a few large projects at the lowest cost per acre foot of storage, or shall we spend more in total on construction for a larger number of smaller projects, but lessen the immediate impact on farming, businesses, residences, fish and game, recreation, etc., within reservoir sites? Is the public interest best served by "large dams" or "small dams," or do we need both in an integrated program? This question cannot be answered fully by a study of the effects of dam construction on agriculture in the reservoir areas. Interests other than agriculture must be considered as well as effects in the downstream areas.

This study, which confines itself to effects of dam construction on agriculture in reservoir areas, has two basic objectives. The first, in the area of methodology, involves measuring the effects. The second, in the area of policy, explores measures to minimize adverse effects from present and future projects. Neither objective is intended to answer, per se, the issue of choice of dam and reservoir sites, nor whether projects should be large or small.

A. Description of Existing Dams and Reservoir Areas

The four reservoir areas studied in this report were: Franklin Falls, involving portions of the cities and towns of Franklin, Hill, Bristol, Sanbornton, and New Hampton: Blackwater, affecting parts of the towns of Webster and Salisbury; Edward MacDowell, including lands in Peterborough, Hancock, Dublin, and Harrisville; and Surry Mountain, containing portions of the town of Surry. The first three areas named are considered part of the Merrimack River Basin. The latter area (Surry Mountain) is part of the Connecticut River Basin.

Table 1 summarizes some of the main features of these four flood control projects.

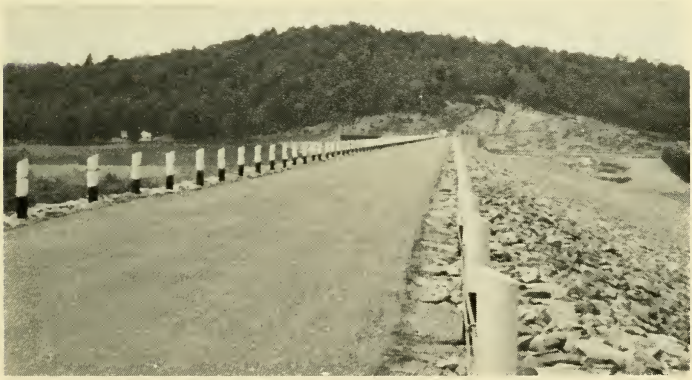
Land use in the reservoir areas was almost entirely agricultural or forest. Dairying was the dominant agricultural enterprise in the four reservoir areas, with poultry and sheep of secondary importance. There were small acreages of orchard, small fruits, vegetables, and potatoes. Much of the land was in forest, including both saw timber and pole size, with about half used for pasture. In the site areas in the towns of Hill and Surry, there were a number of home garden plots associated with urban residences. In general, the land used for agriculture in the Franklin Falls and Surry Mountain reservoir sites was inherently more productive than that in the Blackwater and Edward MacDowell.

It was expected that acquisition of land for reservoir sites would have a greater impact on some enterprises as compared with others. For example, it was expected that acquisition and removal of buildings would entirely displace the poultry enterprise in the reservoir areas. Orchards and small fruit might be removed if located in the dam, winter pool, or borrow areas, or abandoned because of difficulty in carrying out cultural prac-

Blackwater dam, Webster, N. H.

Table 1. Main Features of Four New Hampshire Flood-Control Projects

Name	Franklin Falls	Blackwater	Edward MacDowell	Surry Mountain
River basin	Merrimack	Merrimack	Merrimack	Connecticut
Stream on which located	Pemigewasset River	Blackwater River	Nubansit Brook	Ashuelot River
Cost of project	$7,933,000	$1,324,000	$2,069,000	$1,734,000
Dates of construction	1941-1943	1939-1941	1948-1950	1939-1942
Surface area of reservoir at spillway crest (acres)	2,800	3,140	850	970
Drainage area (square miles)	1,000	128	44	100
Embankment volume (cubic yards)	3,070,000	277,000	210,000	1,105,000
Length of dam (feet)	1,740	1,150	1,000	1,700
Height of dam (feet)	116	69	67	86
Spillway crest storage capacity (acre-feet)	154,000	46,000	12,800	32,500
Elevation at full pool (feet)	416	584	967	568
Elevation at spillway crest (feet)	389	566	946	550
Elevation at low pool (feet)	307	516	905	486



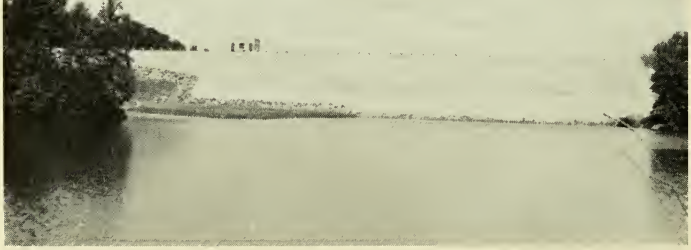
Roadway on top of Surry Mountain dam from east bank, Surry, N. H.

tices, particularly when water was being held in the reservoir. The number of home gardens would be reduced since residences would be removed. However, despite the increased distances from farm buildings, many tracts could still be profitably used for pasture, hay, vegetables, or potatoes. Use of the land for forest would provide the best possibility for much of the land, even providing the opportunity for large scale improved practices by a federal, state, or private operation.

The above assumptions were substantiated by the use of land which was taking place in the post-construction period. Some dairy and livestock farmers who operated lands in the areas prior to acquisition for reservoirs have continued to use these lands under lease for pasture, hay, or cropland. Many former owners have left; some are farming in new locations and there are a few new operators. Several photographs in this bulletin illustrate typical use being made of land for agriculture in the reservoir areas at the present time. The study of pre- and post-construction management and output of woodlands in the reservoir areas is not covered by this report. Such a study, however, might prove interesting and informative as one facet of appraising the total effects of flood control projects.

B. Operational History of the Reservoirs

To provide a basis for comparison of the pre-construction and post-construction agricultural situations, a summary of the history of reservoir operations and their effect on agriculture is presented. Records of land utilization in the Franklin Falls, Blackwater, Surry Mountain, and MacDowell reservoir areas show only a small amount of damage to crops and hayland on the leased areas during the period following construction. In most instances the damages occurred at locations that would be recommended for pasture under good levels of management or by land capability classification. Some operators reported a tendency for legume seedings to run out faster on tracts flooded every year, but this would be expected in any area on wet soils. A few of the lessees mentioned deposition of debris (logs and branches) on areas of pasture which were inundated.



Edward MacDowell dam, West Peterborough, N. H., as seen from Verney dam downstream.

It appears that this debris had its source farther upstream above the reservoir areas and in any case is not a serious problem. Minor deposition of silt was noted on some tracts, but at least one operator claimed this was definitely beneficial.

Within the period covered by available records, it appears that all measurable and reported damage would have been prevented by using the land affected according to land-use capability recommendations. Apparently, the risks involved in using land in the reservoir areas have been greatly exaggerated, at least in terms of 10-20 year estimates and probably for longer periods. If a major flood condition were to occur during the growing season, significant damage to hayland could result; however, major floods in the general area have not occurred at this season. Risks of inundation in the reservoir areas are probably no greater than in most downstream areas and without the velocity associated with floodwater, damage from inundation by backwater at similar depths and duration are likely to be less.

Tables 2-5 show the frequency of inundation to various depths and acreages of land and water at different elevations for the four projects. It should be noted that inundation above certain levels has not occurred during the growing season. Acreage for each contour was determined by planimeter from available maps.

This leased land in the Surry Mountain reservoir area grows silage corn.

Table 2. Franklin Falls Reservoir: Frequency of Inundation[1] to Specified Depths, August, 1943 - October, 1954, and Acreages of Land and Water at Various Contour Elevations

Elevation[2]	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
313.0-319.9	—	2	3	1	2	2	1	—	2	2	1	1	17
320.0-329.9	1	—	3	4	2	2	—	—	—	—	2	2	16
330.0-339.9	—	—	—	3	1	1	—	—	1	—	1	1	8
340.0-349.9	—	—	—	—	GROWING SEASON						—	—	—
350.0-359.9	—	—	—	—							—	—	—
360.0-369.9	—	—	—	—							—	—	—
370.0-379.9	—	—	—	1							—	—	1
Total	1	2	6	9	5	5	1	0	3	2	4	4	42

Contour Elevation[2]	Total Acreage	Land Acreage[3]	Water Acreage[4]
310	545.8	108.4	437.4
320	897.3	383.5	513.8
340	1,796.1	1,233.4	562.7
360	2,258.5	1,679.6	578.9
380	2,701.5	2,106.9	594.6
395	2,961.5	2,354.4	607.1
420	3,587.8	2,954.5	633.3
440	4,208.5	3,567.2	641.3
Purchased	3,781.0[5]	3,104.0	677.0[6]

[1] Non-cumulative.
[2] Feet above mean sea level.
[3] Includes islands.
[4] River-bank level, normal flow.
[5] Excludes borrow areas, Appendix Table II.
[6] Includes water surface and riverwash, Appendix Table II.

Hay grows on this leased land in the Surry Mountain area.

Table 3. Blackwater Reservoir: Frequency of Inundation[1] to Specified Depths, August, 1943 - October, 1954, and Acreages of Land and Water at Various Contour Elevations

Elevation[2]	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
535.0-539.9	—	—	1	4	1	1	—	—	1	—	2	1	11
540.0-549.9	—	—	1	2	1	1	—	—	—	—	—	—	5
550.0-559.9	—	—	—	2	GROWING SEASON						—	—	2
560.0-569.9	—	—	—	1							—	—	1
Total	0	0	2	9	2	2	0	0	1	0	2	1	19

Contour Elevation[2]	Total Acreage	Land Acreage[3]	Water Acreage[4]
542.5	561.6	481.5	80.1
552.5	1,565.4	1,456.5	108.9
562.5	2,469.4	2,350.0	119.4
566.0	2,822.0	2,702.3	119.7
572.5	3,270.6	3,150.1	120.5
Purchased	3,519.0[5]	3,418.0	101.0[6]

[1] Non-cumulative.
[2] Feet above mean sea level.
[3] Includes islands.
[4] River-bank level, normal flow.
[5] Excludes borrow areas, Appendix Table II.
[6] Includes water surface, Appendix Table II.

A Surry Mountain area pasture.

Table 4. Surry Mountain Reservoir: Frequency of Inundation[1] to Specified Depths, December, 1946 - April, 1955, and Acreages of Land and Water at Various Contour Elevations

Elevation[2]	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
498.5-500.0	—	1	1	—	—	—	—	—	—	—	—	—	2
500.1-505.0	1	2	2	—	1	—	—	—	—	1	2	2	11
505.1-510.0	1	2	1	1	—	1	—	—	—	—	—	—	6
510.1-515.0	1	—	—	1							—	1	3
515.1-520.0	1	—	1	1							1	—	4
520.1-525.0	1	—	—	—			GROWING				—	—	1
525.1-530.0	—	—	—	2							1	—	3
530.1-535.0	—	—	—	1			SEASON				—	—	1
535.1-540.0	—	—	—	2							—	—	2
540.1-545.0	—	—	1	—							—	—	1
Total	5	5	6	8	1	1	0	0	0	1	4	3	34

Contour Elevation[2]	Total Acreage	Land Acreage[3]	Water Acreage[4]
490	12.4	9.5	2.9
495	149.6	143.8	5.8
500	243.0	235.6	7.4
505	355.4	344.3	11.1
510	432.2	417.3	14.9
520	556.2	537.2	19.0
525	630.6	610.8	19.8
530	700.8	679.3	21.5
540	852.1	827.3	24.8
550	1,005.8	979.4	26.4
560	1,183.1	1,155.4	27.7
565	1,353.3	1,324.4	28.9
Purchased	1,671.3[5]	1,470.3	201.0[6]

[1] Non-cumulative.
[2] Feet above mean sea level.
[3] Includes islands.
[4] River-bank level, normal flow.
[5] Excludes borrow area and gravel pits, Appendix Table II.
[6] Includes water surface, Appendix Table II. At time of flight, September, 1952, a trial run recreational pool was being maintained. This would have inundated a substantial acreage above river bank level.

Table 5. MacDowell Reservoir: Frequency of Inundation[1] to Specified Depths, April, 1950 - April, 1955, and Acreages of Land and Water at Various Contour Elevations

Elevation[2]	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
915.0-919.9	—	1	2	3	3	—	—	—	—	1	—	—	10
920.0-924.9	—	—	—	2	GROWING						—	—	2
925.0-929.9	—	—	—	1	SEASON						—	—	1
930.0-934.9	—	—	—	1							—	—	1
Total	0	1	2	7	3	0	0	0	0	1	0	0	14

Contour Elevation[2]	Total Acreage	Land Acreage	Water-Acreage[3]
920	130	90	30
940	445	388	57
960	1,152	973	179
967	1,235	1,154	181
Purchased	1,289[4]	1,105	184[5]

[1] Non-cumulative.
[2] Feet above mean sea level.
[3] River-bank level, normal flow plus ponds.
[4] Excludes borrow areas, Appendix Table II.
[5] Includes water surface, Appendix Table II.

This land in the Franklin Falls reservoir area was formerly part of a small dairy farm. Despite the fact that at least part of it is flooded every spring, the land is now used for sweet corn, squash, potatoes, and legume-grass seedings.

2. Agricultural Use: Pre- and Post-Construction

What has happened to agriculture in the flood-control reservoir areas since acquisition of the land by the federal government and construction of the dams? Is there more or less agricultural production? To answer these questions in detail requires a comparison of measurements made at the two points in time. Comparison of conditions for these two periods must deal with an unusual situation. The pre-construction agricultural production was carried out by individuals operating farm units typical of the local situation. In the post-construction condition, private holdings have been consolidated under federal ownership and a certain portion leased for agricultural use under competitive bidding.

In this situation a complete farm and tract survey would be the best means of making a comparison of conditions. However, such a pre-con-

A field formerly part of a large and productive farm in the Franklin Falls area. Hay yields declined to about one-fourth of immediate post-construction level in a decade with little or no treatment. A new lessee planned to plant silage corn.

struction survey was not made of the farms and tracts in the reservoir areas, although some data were obtained in the process of land appraisal and acquisition of the sites. It was therefore necessary to develop a methodology, using all data available to approximate a complete farm and tract survey. A detailed discussion of the method developed and the source and types of data used are given in Appendix I.

In comparing agricultural production from the reservoir in two periods, it must be recognized that many trend changes would be expected over a time period of 15 to 20 years. In the case of Franklin Falls, Blackwater, and Surry Mountain, the time period extended from about 1938 to 1955, while for the Edward MacDowell Reservoir it extended from about 1948 to 1955.

During this period, production techniques have been modified by research and experience. In many cases, improved technology would provide the means to obtain higher yields at present as compared to the pre-construction situation. It would now be possible to obtain the former output of production on a smaller number of acres. However, in actual practice, farm operators may not adopt the latest methods, particularly on leased reservoir land. In addition to change in technology, some adjustments would also be expected in the types of farm enterprise and their relative importance.

The shift from private to public ownership presents a number of possibilities to be considered. Such a change may make farm operators reluctant to treat leased land as carefully as that which they own. Reservoir lands may become marginal to operation of the privately-owned land and receive only residual treatment. However, some operators do not practice optimum management even on land which they own. There is a possibility that in some cases the reservoir land might be inherently more productive than the land in private ownership.

In April, 1953, when Franklin Falls Resevoir was three-quarters full, water left this log in a tree on Main street of the old Hill, N. H. Adjacent areas are used for vegetables, hay, and pastures. Lessees report no measurable losses from inundation.

The willingness of farm operators to use leased lands in optimum fashion will also depend to a great degree upon their estimates of the frequency, duration, and time of inundation of land available for lease in the reservoir areas. There have been appreciable differences in these estimates based on individual or group judgment. In general, it would appear that risks have been over-estimated, which has had a depressing effect on post-construction values.

It is possible, in comparing pre- and post-construction agricultural production, to confine comparisons to "actual" levels. However, in doing so there may be a chance bias in the post-construction situation. The post-construction production might vary considerably depending on the operators using reservoir lands on leases by competitive bidding. Again, "actual" post-construction levels of management may reflect exaggerated estimates of the danger of loss from inundation.

In the case of pre-construction "actual" conditions there is a chance for bias since there would be a range of levels of operation depending on differences between individual operators, and the manner in which the land was held.

With the above factors prevailing, it was decided to derive two initial sets of output comparisons — one at the "actual" level of management and the other at a level of management designated as "optimum". Using the method and data discussed in Appendix I, the two levels of agricultural production were determined for the two periods involved. The output for both periods at the "actual" level is the summation of unit-by-unit estimates of number of livestock, acreage of crops and yields. Level of management represents what the operator was doing. In both periods, a certain amount of land was idle. In neither period, was land use of any given unit the best use, either in terms of immediate income possibility or according to conservation principles.

In estimating "optimum" use, management was standardized and idle land used somewhat in proportion to the segments making up total use. Per-acre yields were established at a level equivalent to the average for several of the more efficient operators. So far as land use was concerned, no material changes from the actual use was made. Table 6 summarizes the assumptions involved in the comparison of output for the two time periods at the different levels of management.

Basic to both sets of comparisons was the inclusion under productive man-hours of the livestock which could be carried with given acreages. Physical presence of the livestock on a given farm was not considered necessary to make allowance for the man-work units commensurate with the land. In the pre-construction period, buildings and land were usually adjacent, although operators from outside the reservoir area did own or use some tracts. In the post-construction period all buildings had been removed. In general, it appears that farmer-owners received the current value for farm buildings, although not necessarily the replacement cost. Hence, in theory, they could attempt establishment of farmsteads outside the reservoir at no long-time loss, with current value taking in account depreciation credited to operations in previous years. Farmstead sites would be far easier to establish than complete farm units, particularly since good farm lands were limited. In practice, as farm units increase in size and decrease in number, many tracts at some distance from the farmstead are being integrated into one operation. Thus, the displacement of farm buildings is not the critical factor it once would have been before mechanization, specialization, and increase in size had become accelerated. Therefore, the critical effect of the reservoir program comes largely from the farm land affected and the limitations on its use.

A. Pre- and Post-Construction "Actual" Levels

Table 7 summarizes the shifts in land use that have actually taken place between the pre- and post-construction periods. Explanation of the terms used and units of measurement will be found in Appendix I.

Some of the significant changes between the two periods are the following:

a. Decline in the total number of acres used for agriculture, ranging from 44 percent in Franklin Falls to 74 percent for Edward MacDowell.

b. Elimination of orchards and small fruits as farm enterprises in the reservoir areas.

Table 6. Assumptions Involved in Two Sets of Output Comparisons

Situation and period	Ownership	Boundaries	Level of Management	Acreage Used	Types of Uses	Risk
"Actual"						
Pre-construction	Private	Private Ownership	Actual	Actual, with some idle	Actual	Operator's appraisals
Post-construction	Public	As Leased	Actual	Actual, with some idle	Actual	Lessee's appraisals
"Optimum"						
Pre-construction	Private	Private Ownership	Optimum	Same as "actual", but none idle	Actual projected	Operator's appraisals
Post-construction	Public	As Leased	Optimum	Same as "actual", but none idle	Actual projected	Lessee's appraisals

c. Decline in acreage of silage corn, commercial vegetables, and potatoes. Home gardens decreased due largely to removal of urban residences.

d. Decline in the acreage of hayland, open pasture, and brush pasture. Use of land for hay appears to have decreased relatively more than use of land for pasture. On the smaller pasture acreage, relatively more young stock and dry cows are carried and fewer milk cows.

Per-acre yields of silage corn do not appear to have changed significantly. Per-acre yields of hay and the carrying capacity of pastures show no uniform rate or direction of change. In the Surry Mountain area, hay yields declined 50 percent from the pre-construction to the post-construction period, and in the MacDowell area, did not change, while in the Franklin Falls and Blackwater areas, yields increased 12 and 60 percent, respectively.

In the Surry Mountain area, 3.9 acres of pasture were used per mature cow equivalent in the pre-construction period and, in the post-construction period, 4.5 acres. Respective figures for Blackwater were 5.5 and 2.8, and for Franklin Falls, 5.1 and 4.1 acres.

In terms of livestock numbers supported by lands in reservoir areas, the greatest relative decline from pre- to post-construction took place in the Surry Mountain area, followed by Edward MacDowell. Edward MacDowell was and is at present the least important agricultural area. The decline in livestock numbers was smallest in the Blackwater area.

Total man-hours on crops and livestock declined during this period by 78 percent for Surry Mountain, 62 percent for MacDowell, 50 percent for Franklin Falls, and 40 percent for Blackwater.[1]

B. Pre- and Post-Construction "Optimum" Levels

During both pre- and post-construction periods the level of management used by the operators varied a great deal. By raising the average level of management to that practiced by the better operators, some increases in yields and carrying capacity of the land could be achieved. (Tables 8-10.)

The adjustment of post-construction management levels from the "actual" to the "optimum" involves in most cases a greater percentage increase in yields and carrying capacity than does the same adjustment of pre-construction management levels. This occurs because of the residual treatment many post-construction operators accord leased reservoir lands. "Actual" post-construction average yields and carrying capacity are generally lower relative to "optimum" levels than was true in the pre-construction period.

Many pieces of agricultural land were left idle during both pre- and post-construction periods. Under an "optimum" level of use of the reservoir land such pieces would be used for farming. After bringing them into use, and assuming "optimum" levels of management, land use patterns would still contain the following shifts from pre- to post-construction:

a. Declines in the total number of acres used for agriculture, ranging from 49 percent for Franklin Falls to 72 percent for Blackwater.

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[1] Total annual man-hours per head or per acre were interpolated from data presented by G. E. Frick and W. K. Burkett, "Farm Management Reference Manual," N. H. Ext. Cir. 307, September, 1953, p. 46. See Appendix Table VII.

Table 7. Measures of Agricultural Output, Four Reservoir Areas, Pre- and Post-Construction Periods, Under "Actual" Conditions

	Franklin Falls		Blackwater		Edward MacDowell		Surry Mountain	
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-
Acres:[1]	1,416.30	790.15	950.20	343.30	113.06	29.10	1,035.7	372.93
Silage	41.50	—	13.40	6.00	.56	—	44.30	3.00
Hay	308.85	171.00	214.00	132.30	68.50	29.10	348.00	135.00
Open pasture	459.70	349.20	262.80	133.10	22.70	—	274.10	117.50
Brush pasture	590.70	263.45	441.00	71.70	21.30	—	366.80	117.43
Orchards	5.55	—	3.00	—	—	—	—	—
Small fruits	—	—	10.00	—	—	—	—	—
Commercial vegetables	7.50	5.75	—	—	—	—	2.50	—
Potatoes	2.50	.75	6.00	.20	—	—	—	—
Home gardens	12.45	3.00	3.30	.20	.50	1.80	7.90	.20
Roughage-forage output:								
Silage (tons)	535.0	—	143.0	60.0	4.0	—	523.8	33.0
Hay (tons)	400.5	249.0	179.5	187.8	64.8	27.0	545.5	111.5
Pasture (A.U.G.)[2]	207.3	150.8	127.6	73.0	8.3	—	165.3	51.7
Livestock, head equiv.:								
Cows	115.0	55.2	46.5	33.5	10.6	3.6	112.5	27.4
Young stock	116.4	98.1	50.5	44.2	7.6	3.6	99.4	30.6
Horses	15.0	—	8.0	—	1.0	—	11.0	—
Sheep	—	—	90.0	44.0	6.0	—	—	—
Hens	490.0	—	—	—	—	—	1,929.0	—
Chickens	980.0	—	—	810.0	—	—	3,858.0	—
Man hours:	23,706	11,869	11,466	6,823	1,936	732	22,309	4,883
Cows, youngstock, sheep	15,862	8,283	6,534	5,136	1,420	528	14,923	3,658
Hens and chickens	982	—	—	202	—	—	2,256	—
Crops for livestock	4,005	2,104	2,122	1,473	516	204	4,505	1,225
Orchards	832	—	450	—	—	—	—	—
Small fruits	—	—	2,000	—	—	—	—	—
Commercial vegetables	1,875	1,437	—	—	—	—	625	—
Potatoes	150	45	360	12	—	—	—	—
Home gardens	2,993	750	825	50	125	450	1,975	50

[1] In use for agriculture, excluding home gardens. [2] A.U.G. — Animal Units Grazed. [3] Total, excluding home gardens.

b. Elimination of orchards and small fruits, declines in acreages of silage, commercial vegetables, potatoes, and home gardens.

c. Declines in acreages of hayland, open pasture, and brush pasture. Projection of a greater decline in hayland than in pasture, and a continued tendency to use pasture relatively more for young stock and dry cows than for milk cows.

A comparison of the pre- and post-construction "optimum" levels of management shows that crop yields and carrying capacity of pasture would, in general, be higher in the post-construction period.

Table 8. Increase in Yield or Capacity per Acre from "Actual" to "Optimum" Conditions

Area	Hay		Silage		Pasture	
	Pre-	Post-	Pre-	Post-	Pre-	Post-
			(Percentage Increase)			
Surry	12	141	19	64	0	73
Blackwater	43	23	12	20	0	30
Franklin	23	37	11	*	15	68
MacDowell	26	61	41	*	21	*

* Not determined.

Table 9. Change in Yield or Capacity per Acre from Pre- to Post-Construction Under "Optimum" Conditions

Area	Hay	Silage	Pasture
		(Percentage Increase)	
Surry	11	0	46
Blackwater	46	0	161
Franklin	25	0	83
MacDowell	25	0	65

Despite assuming full use of owned and leased lands in the pre- and post-construction periods, respectively, and higher management levels, the decline of 50 to 70 percent in acreages used for agriculture under the "optimum" comparisons was sufficient to still affect substantial drops in output.

Generally, however, post-construction outputs under "optimum" assumptions were higher relative to pre-construction outputs than was the case under "actual" assumptions. This is indicative, for most of the areas, that the "actual" post-construction level of management was low relative to current technology. In fact, in some instances, per acre yields were actually lower than in the pre-construction period.

Table 10. Changes in Total Livestock, Total Farm Work, and Total Acres in Farming from Pre- to Post-Construction Under "Actual" and "Optimum" Conditions

Area	Total Livestock		Total Annual Man Hours		Total Acres	
	Actual	Optimum	Actual	Optimum	Actual	Optimum
			(percentage decline)			
Surry	78	60	78	62	74	65
Blackwater	31	38	40	37	64	72
Franklin	44	26	50	37	44	49
MacDowell	66	44	62	45	74	64

Land brought into use under the "optimum" assumptions as compared to the "actual" assumptions was much greater under pre- than under post-construction conditions. The additions to land in agricultural use under pre-construction conditions was almost ten times the addition under post-construction conditions in the Franklin Falls area. For Blackwater, the ratio was more than 30 to 1; for MacDowell, 1½ to 1; and for Surry Mountain, more than 3 to 1. All but a small percentage of the land added under pre-construction comparisons was pasture. In the post-construction comparisons, pasture still accounted for about half the net addition.

In the pre-construction period, individual holdings included substantial acreages of unused land (unused for agriculture, i.e., brush and woodland pasture, hayland, etc.). In the post-construction period, operators had the opportunity to lease tracts as they saw fit and to delineate boundaries. This meant they could pick out the better portions of one or more tracts. Where leased tracts were being used rather fully, as in the Blackwater and Franklin Falls areas, the shift from "actual" to "optimum" assumptions decreased the percentage which post-construction acreage was of pre-construction acreage. In MacDowell and Surry Mountain, where leased tracts were not fully used, the reverse happened.

For Franklin Falls, MacDowell, and Surry Mountain, better use of a smaller acreage under "optimum" conditions resulted in smaller percentage declines in output (as measured by either livestock numbers or man hours from the pre- to post-construction periods than under "actual" conditions. With Blackwater, however, the proportion and amount of idle farmland in the pre-construction period was so great that its inclusions in use raised "optimum" pre-construction output sufficiently so that the reverse happened.

Percentage declines in output, as measured by livestock numbers and man hours, were relatively consistent for "actual" and "optimum" conditions for MacDowell and Surry Mountain, and for "optimum" conditions for Blackwater. For "actual" conditions for Blackwater and for "optimum" and "actual" conditions for Franklin Falls, total man hours declined relatively more than livestock numbers. For Franklin Falls, this results primarily from the relatively greater shift to using land resources for young stock than for milk cows, but also in part from the decline in orchards, vegetables, and potatoes. For Blackwater, the difference is largely due to the decline in small fruits, orchards, and potatoes.

Table 11. Measures of Agricultural Output, Four Reservoir Areas, Pre- and Post-Construction Periods, Under "Optimum" Conditions

	Franklin Falls		Blackwater		Edward MacDowell		Surry Mountain	
	Pre-	Post-	Pre-	Post-	Pre-	Post-	Pre-	Post-
Acres:[1]	1,638.31	830.92	1,302.50	367.60	147.59	52.40	1,144.70	405.58
Silage	48.50	10.00	20.40	10.00	4.56	2.00	44.30	10.00
Hay	324.85	181.00	237.10	142.30	94.53	29.10	353.39	145.00
Open pasture	545.30	359.20	280.30	138.10	27.20	15.00	289.33	122.50
Brush pasture	704.11	274.22	745.70	77.00	21.30	6.30	455.18	128.08
Orchards	5.55	—	3.00	—	—	—	—	—
Small fruits	—	—	10.00	—	—	—	—	—
Commercial vegetables	7.50	5.75	—	—	—	—	2.50	—
Potatoes	2.50	.75	6.00	.20	—	—	—	—
Home gardens	12.45	3.00	3.30	.20	.50	1.80	7.90	.20
Roughage-forage output:								
Silage (tons)	679.0	180.0	244.8	120.0	45.6	20.0	620.2	180.0
Hay (tons)	519.8	362.0	284.5	249.0	113.4	43.6	636.1	290.0
Pasture (A.U.G.)[2]	288.5	268.1	186.7	100.2	11.1	8.1	190.2	94.9
Livestock, head equivalent:								
Cows	154.1	95.5	71.1	46.2	17.4	9.9	131.6	57.5
Young stock	156.0	169.7	77.3	61.0	12.5	9.9	116.3	64.3
Horses	20.1	—	12.2	—	1.6	—	12.9	—
Sheep	—	—	137.7	60.7	9.8	—	—	—
Hens	490.0	—	—	—	—	—	1,929.0	—
Chickens	980.0	—	—	810.0	—	—	3,858.0	—
Man hours:[3]	29,907	18,836	15,415	9,657	3,104	1,721	25,727	9,808
Cows, youngstock, sheep	21,255	14,330	9,997	7,366	2,329	1,457	17,459	7,682
Hens and chickens	982	—	—	202	—	—	2,256	—
Crops for livestock	4,813	3,024	2,608	2,077	775	264	5,387	2,126
Orchards	832	—	450	—	—	—	—	—
Small fruits	—	—	2,000	—	—	—	—	—
Commercial vegetables	1,875	1,437	—	—	—	—	625	—
Potatoes	150	45	360	12	—	—	—	—
Home gardens	2,993	750	825	50	125	450	1,975	50

[1] In use for agriculture, excluding home gardens. [2] Animal Units Grazed. [3] Total, excluding home gardens.

In both the pre- and post-construction "actual" and "optimum" comparisons, large acreages of brush and woodland pasture were used. In the comparisons of "potential capacity", developed in a later section, use of brush and woodland pasture is drastically curtailed. Much of such areas would probably be better used from both the conservation and economic approaches as parts of large-scale wood or lumber lots or as recreational, or fish and game areas.

The "actual" comparisons reflect the demand for lands for agriculture in terms of the number, size, and types of enterprises existing in the pre- and post-construction periods. In the post-construction period, of course, such demands in the reservoir area also reflect lessees' or prospective lessees' expectations of losses from inundation, inaccessibility of certain tracts, and dissatisfaction with leasing arrangements. Neither the "optimum" nor the "potential capacity" comparisons attempt to adjust for the demand (or actual need) for lands for agriculture. The effect of trends in agriculture on post-construction output is discussed in a later section which attempts to derive some residual effects of the projects on actual output.

C. Post-Construction "Potential" Level

Relatively large proportions of the land suitable for agriculture have remained idle since construction of the projects. This reflects a combination of factors: the demand for farm land, lessee's and prospective lessee's appraisals of risks, inaccessibility of certain tracts, and the impact of public acquisition, ownership, and leasing arrangements. Yet the "potential capacity" of these lands today is such that the area could equal or exceed pre-construction output. In the event that such lands were required for agricultural use, their reorganization into economic units (according to capabilities), institution of optimum levels of management, and conversion of all resources to the highest income possibilities would accomplish this objective.

In determining the "potential capacity" of reservoir lands, projections are confined to two periods, i.e., immediate and present post-construction. Shifts in uses, boundaries, and management levels of the magnitude required would have been extremely unlikely under the pre-construction ownership pattern. The difference in the two projected values is due to elapsed time. From the immediate post-construction years much land has grown up and is reclaimable for agricultural use only after reclearing. As time goes on, the "potential capacity" will decline at an accelerated rate on unused lands.

Table 12. Assumptions Involved in Projections of "Potential Capacity" of Reservoir Lands

Period	Ownership	Boundaries	Level of Management	Acreage Used	Types of Uses	Risk
Immediate and present post-construction	Public	Interpolated, using risk and use data	Optimum	Open, suitable for agriculture*	Optimum	Flooding history, based on experience to date

* Without reclaiming.

Estimates of "potential capacity" make use of actual risks based on inundation and damage records, and knowledge of crop tolerances, rather than on prospective user's expectations of risk. Season of the year is the most critical point relative to inundation of reservoir lands. If these lands are covered during the fall, winter, or early spring months (before actual work can be accomplished), little damage may result.

One assumption involved in the projections in Table 13 is the separation of lands into those which may be flooded during the growing season as compared to those which, to date, have not been flooded during the growing season. The former lands are treated in Table 13 calculations as best adapted to pasture. Certain additional lands are also deemed best used for pasture because of adjacency to lands which may be flooded during the growing season, or to give access to higher grounds in case that flooding of such lands happened. Based on records covering various periods, it appears that in the Franklin Falls Reservoir the critical elevation is around 340 feet, for the Blackwater Reservoir, around 550 feet, and for Surry Mountain Reservoir, around 510 feet. The inundation of pasture lands during the grazing season is certainly an inconvenience. Yet, with an adequate warning service and the probability that such lands would be covered only a day or two, they could furnish suitable pasture for most of the time without serious drawback. However, crop lands and haylands, which require more frequent and intensive cultivation and/or seeding, would require some positive assurance that such operations would not often be interrupted during the growing season by flooding.

A significantly smaller amount of land is now suitable for agriculture than in the period immediately after the construction of the dams. Much land which could have been used conveniently after construction for crop

The former owner still leases this tract behind Franklin Falls dam for hay and pasture. He no longer plants corn on part of this farm.

and hay land now is suitable only for open pasture. Some of this land, together with some of the land which formerly was open pasture, has now grown up to the point where it can be used only for brush pasture. Land from the two preceding classes, as well as land which was formerly used for brush pasture, has now grown up to such an extent that it should be left in ungrazed forest or wood land.

However, with the changes in technology, a smaller amount of acreage at present can produce almost as much output as a larger amount of land formerly. Thus, with higher per-acre yields or carrying-capacity of pasture, the substantially smaller acreages of land suitable for agriculture in the reservoir areas could now result in a total of man hours almost as large as could be estimated for the immediate post-construction period.

Part of this tract behind Blackwater dam has been planted to corn with poor results due to excessive water.

Some general conclusions can be drawn by comparing Table 7 and 11 with Table 13. These are confined to aggregate acreages and aggregate man hours, since other data are in a sense contributory to these major items. Both the immediate and present post-construction "potential" estimates exceed the pre-construction "actual" estimates by a significant margin, both in terms of acreage and man hours, and substantially exceed post-construction "actual" estimates. This indicates under-utilization of reservoir lands, both in the pre- and post-construction periods. This stems from the fact that there were considerable acreages of land which were associated with agricultural enterprises, but not directly used for agriculture, and the fact that levels of management were somewhat low. For both Franklin Falls and Blackwater the immediate post-construction "potential" estimates were somewhat lower than the pre-construction "optimum" estimates in terms of total man hours. For Surry Mountain the reverse is true. In terms of total acreage suitable for agricultural use, somewhat more land could have been used in the Franklin Falls and Surry Mountain areas under the immediate post-construction "potential" estimates than under the pre-construction "optimum" estimates, and about the same acreage for the Blackwater area. Present post-construction "potential" estimates for all three reservoir areas considerably exceed post-construction "optimum" estimates, both in terms of acreages and man work units.

The pre-construction "optimum" estimates were, of course, based on bringing into utilization all of those lands associated with agricultural enterprises, and of raising the level of management to that which was carried out by the better operators at that point in time. With the acquisition of reservoir lands and the building of the dams, the risks which were involved changed. Thus, in developing the immediate post-construction "potential"

Table 13. Measures of the "Potential Capacity" of Lands in Three Reservoir Areas, Immediate and Present Post-Construction Periods

	Franklin Falls		Blackwater		Surry Mountain	
	Immediate	Pres.	Immediate	Pres.	Immediate	Pres.
Acres[1]	1,729.3	1,251.9	1,297.6	647.9	1,251.7	1,017.5
Silage	40.0	25.0	15.0	10.0	50.0	30.0
Hay	299.5	210.6	175.8	130.4	354.5	264.3
Open pasture	683.8	560.7	339.3	242.6	344.6	290.2
Brush pasture	698.0	447.6	767.3	264.7	502.6	433.0
Com'l. vegetables	7.25	7.25	—	—	—	—
Potatoes	.75	.75	0.2	0.2	—	—
Home gardens	3.00	3.00	0.2	0.2	0.2	0.2
Roughage-forage output:						
Silage (tons)	560.0	450.0	180.0	120.0	700.0	540.0
Hay (tons)	479.2	421.2	211.0	228.0	638.0	529.0
Pasture (A.U.G.)[2]	343.3	420.3	212.4	189.0	22.6	237.7
Livestock head equiv.:						
Cows	144.2	123.9	59.1	58.9	149.5	144.4
Young stock	200.3	243.7	123.1	94.5	188.9	154.0
Man hours:[3]	26,857	25,738	11,752	10,930	27,235	24,411
Cows, young stock	20,429	19,703	9,602	8,726	20,617	19,056
Crops for livestock	4,571	4,178	2,138	2,192	6,618	5,355
Com'l. vegetables	1,812	1,812	—	—	—	—
Potatoes	45	45	12	12	—	—
Home gardens	750	750	50	50	50	50

[1] In use for agriculture, excluding home gardens.
[2] A.U.G. — Animal Units Grazed.
[3] Total, excluding home gardens.

estimates, the down-grading of certain tracts, based on risks of flooding, was involved. To some extent, this downgrading of land was offset by the assumed bringing into production of certain additional tracts which were not associated with agricultural enterprises in the pre-construction period, but which were, by virtue of their characteristics, deemed suitable for that purpose. For the Franklin Falls and Blackwater areas, it appears that the down-grading of agricultural lands due to increased risks were greater than the effect of the idle land brought into use, whereas in the Surry Mountain area the down-grading of land because of increased risks was less than the effects of bringing additional lands into production.

In the post-construction "optimum" estimates, it was assumed that the entire tracts rented would be brought into agricultural use. This resulted in some increases in agricultural output as compared to the post-construction "actual" estimates. In the present post-construction "potential" estimates, a number of additional areas of land would be brought into agricultural

use, and although there is some down-grading of agricultural land because of risks as compared to the uses actually made of them by some operators, there would be an increase in output from the reservoir areas.

Inherently, the "potential" comparisons imply the maintenance of suitable access roads, the current absence of which practically precludes certain tracts from use for agriculture. This cost might be offset in part by increased revenues from leases and also in part by considering the costs for fire-prevention or recreational purposes.

Significant adjustments involved in determining the "potential capacity" of reservoir lands in the present post-construction period are: conversion of all possible land resources to dairying, and in particular for use through milk cows. In comparison to pre- and post-construction "actual" and post-construction "optimum" levels, such lands would carry substantially more milk cows and young stock. Immediate post-construction "potential capacity" estimates, compared to pre-construction "optimum" levels, would show increased numbers of young stock for all areas; more milk cows for Surry Mountain, but fewer for Franklin Falls and Blackwater.

3. Comparison of Agricultural Trends in Reservoir and Non-Reservoir Areas

Local areas which have borne the impact of flood control projects have also been subject to the same forces which have caused changes in agriculture and other enterprises. The long-time movement of resources out of agriculture in New Hampshire is reflected in most subdivisions of the state. Substantial amounts of agricultural land have been and are being converted to residential, industrial, and recreational use as well as to forest. Table 14 shows this trend for New Hampshire. This trend must be given due weight in the reservoir areas along with evaluation of direct effects of project construction.

Table 14. Trends in New Hampshire Agriculture, 1940-1954

Item		1940	1949-1950	1954
Farms	(no.)	16,554	13,391	10,411
Land in farms	(acres)	1,809,314	1,713,731	1,457,293
Average size of farms	(acres)	109.3	128.0	140.0
Cropland harvested	(acres)	371,611	290,199	246,583
Cropland used for pasture	(acres)	173,073	101,428	87,719
Woodland pastured	(acres)	*	295,110	228,110
Other pasture (not cropland and not woodland)	(acres)	*	148,702	116,992
Commercial farms	(no.)	*	6,393	5,425
Other farms	(no.)	*	6,998	4,988
Milk cows	(no.)	72,399	56,685	59,213
Cattle and calves	(no.)	115,681	109,658	118,015
Horses and mules	(no.)	13,999	8,724	5,210
Sheep and lambs	(no.)	7,854	7,423	10,305
Corn for silage	(tons)	105,000	104,000	124,000
Hay cut	(tons)	400,000	391,000	383,000
Chickens on hand	(1,000)	1,363	1,988	2,667
Chickens sold	(1,000)	2,850	4,819	8,004

* Not available.

Source: Census of Agriculture, Bureau of the Census, and Agricultural Statistics, USDA.

The movement toward fewer and larger farms has meant that land holdings have become consolidated under fewer operators. Census figures show little disposition for the practice of tenancy to increase in the state. Thus, consolidation has probably come about to a great extent through outright purchase of additional lands, with some formal leasing and a fair amount of informal short-run arrangements for cutting standing hay or pasturing fenced tracts. With this trend operating, many units in the reservoir areas might have been eliminated or consolidated in the absence of the projects. The projects probably hastened these adjustments.

A. Reservoir vs. Non-Reservoir Towns

An attempt to measure the influence of these trends in the reservoir towns will be made by comparison with conditions in nearby towns. Several types of data are available for towns, particularly the number of roughage-consuming livestock. Data on livestock are collected annually by towns for taxing purposes. A comparison of trends in the number of livestock in towns affected by the projects, and those adjacent, provides one means of estimating the general trend of agriculture in the area. Basically, the number of roughage-consuming livestock would indicate the general movement of land and other resources into and out of agriculture, since the areas in question were and are in dairying for the most part. Sheep and beef cattle are relatively unimportant. Horses must still be considered in pasture and hay utilization, although they are now used mostly for woods work and riding, rather than as farm work animals.

Towns included in the comparisons, covering the years 1935-1953, inclusive, are listed below:

Project	Reservoir Towns	Adjacent Towns
Franklin Falls	Franklin	Tilton
	Hill	Northfield
	Sanbornton	Meredith
	New Hampton	Ashland
	Bristol	Bridgewater
		Alexandria
		Danbury
Blackwater	Webster	Andover
	Salisbury	Warner
Surry Mountain	Surry	Gilsum
		Alstead
MacDowell	Peterboro	Jaffrey
	Hancock	Marlborough
	Harrisville	Roxbury
	Dublin	Nelson
		Temple
		Sharon

Data on livestock were taken from annual reports furnished to the New Hampshire State Tax Commission and are summarized in Figures 2 and 3. These data were totaled and converted to mature cow equivalents on the basis that a cow, horse, ox, or meat animal is equivalent to one and a sheep equivalent to one-fifth.

Figures 2 and 3 indicate similar general downward trends in the number of livestock in the reservoir towns and those adjacent. For towns affected by the Franklin Falls and MacDowell projects, the rate of decrease during the period is relatively greater in the reservoir towns, while for Surry Mountain and Blackwater, the reverse is true.

In all areas, the numbers tended to increase during World War II and following the war resumed the downward trend. For all four groups of reservoir towns, the number decreased noticeably during the late stages of project construction, but returned to the long-time trend pattern after construction was completed.

Figure 2. Number of taxable roughage-consuming livestock, 1935-53, in Franklin Falls and Blackwater areas.

During the period, downward adjustments in livestock numbers were relatively less for the Blackwater and Surry Mountain reservoir towns than for the adjacent towns. Adjustments for Franklin Falls and MacDowell reservoir towns were relatively greater than for the adjacent towns. However, from the three-year period preceding construction to the three-year period following, all four groups of reservoir towns showed a greater relative decline in livestock numbers than the corresponding groups of nearby towns. This relationship is shown in Table 15. The differences in long-term trends in livestock numbers in both groups could be attributed, to some extent, to heterogeneous sample areas.

B. Reservoir vs. Non-Reservoir Lands in Reservoir Towns

The pre- to post-construction shifts determined on the basis of town totals obscure the total effects of the projects on the reservoir land component itself. This effect might arise from the disruption or suspension of normal activity, actual work on some areas, or uncertainty regarding both property acquisition or possible future use of the area.

In Table 16, data for reservoir towns are separated into livestock numbers supported by reservoir and non-reservoir lands. These data show greater relative declines for the reservoir lands. Present livestock numbers supported by reservoir lands range from 22 percent of pre-construction for Surry Mountain, to 56 percent for Blackwater. On the other hand, present livestock numbers supported by non-reservoir lands range from 67 percent for Franklin Falls, to 82 percent for Surry Mountain.

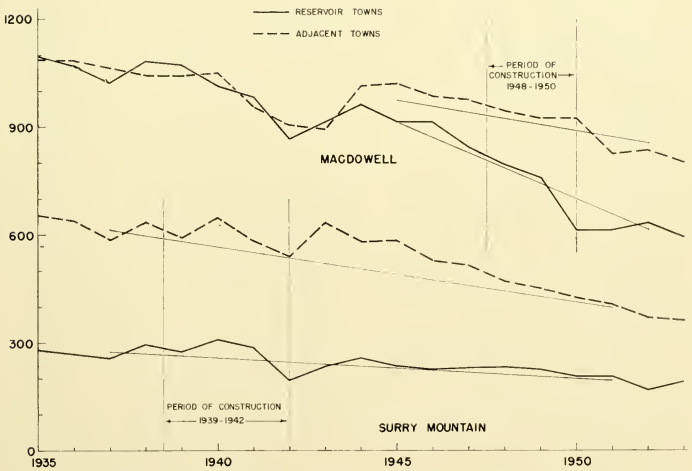

Figure 3. Number of taxable roughage-consuming livestock, 1935-53, in MacDowell and Surry Mountain areas.

Table 15. Changes in Numbers of Taxable Roughage-Consuming Livestock, Reservoir and Adjacent Towns, Pre- and Post- Construction and Long-Range Trend

Towns	Franklin Falls			Blackwater			Surry Mountain			MacDowell		
Averages, 3 years before and after construction												
	1938-40	1944-46	1944-46 as % 1938-40	1936-38	1942-44	1942-44 as % 1936-38	1936-38	1943-45	1943-45 as % 1936-38	1945-47	1951-53	1951-53 as % 1945-47
Reservoir	1,845	1,612	87.3	616	529	85.8	275	242	88.0	889	615	69.1
Adjacent	2,018	1,951	96.7	737	673	91.4	621	600	96.5	993	855	86.1
Averages, 5 earliest and 5 recent years:*												
	1935-39	1949-53	1949-53 as % 1935-39	1935-39	1949-53	1949-53 as % 1935-39	1935-39	1949-53	1949-53 as % 1935-39	1943-47	1951-53†	1951-53 as % 1943-47
Reservoir	1,949	1,273	65.3	619	425	68.7	276	199	72.1	909	615	67.7
Adjacent	2,212	1,639	74.1	770	479	62.2	622	402	64.6	977	855	87.5

* Trend lines on Figures 2 and 3 are drawn between average values and midpoint years given below.

† Three-year averages.

Table 16. Number of Taxable Roughage-Consuming Livestock Supported by Reservoir and Non-Reservoir Lands in Reservoir Towns, Pre-Construction and Present Periods

Lands	Franklin Falls			Blackwater			Surry Mountain			MacDowell		
	Pre-Constr.	Present	Present as % Pre-Constr.	Pre-Constr.	Present	Present as % Pre-Constr.	Pre-Constr.	Present	Present as % Pre-Constr.	Pre-Constr.	Present	Present as % Pre-Constr.
Reservoir lands	154.1	65.7	42.6	142.6	31.8	22.3	87.8	49.0	55.8	14.2	4.5	31.0
Non-reservoir lands	1,794.9	1,207.3	67.3	476.4	393.2	82.5	188.2	150.0	79.7	894.8	610.5	68.2

While it would be theoretically possible for output from reservoir lands to approach or exceed "actual" pre-construction levels on the basis of post-construction "optimum" or "potential" calculations, demand for agricultural lands in these areas is presently insufficient to realize the necessary expansion in acreage or intensification of use. However, by some rather moderate adjustments within the present framework, preferably of the type suggested under "potential capacity" estimates, output from reservoir lands could easily parallel that from non-reservoir lands in the same towns. These are summarized in Table 17.

Table 17. Adjustments Needed to Enable Reservoir Lands to Support Proportionate Number of Taxable Roughage-Consuming Livestock to Those Presently Supported by Non-Reservoir Lands in Reservoir Towns

Project	
Franklin Falls	Full use of presently-leased tracts at optimum level of management.
Blackwater	Full use of presently-leased tracts at optimum level of management.
Surry Mountain	Full use of presently-leased tracts at optimum level of management: *plus use of additional tracts.*
MacDowell	Full use of presently-leased tracts* at optimum level of management.

* Including tracts suitable for leasing on which inquiries received.

Only in the Surry Mountain reservoir area would a significant increase in acreage be required. In the other areas sufficient increase in output could be accomplished by full use of tracts presently under lease, including a higher level of management. Such a level would be entirely feasible in view of actual risks and the practices of the better operators now using reservoir lands.

C. Residual Effects of Flood Control Projects

A substantial proportion of the reduction in agricultural output from the reservoir lands would probably have occurred even in the absence of the projects. This is borne out by the trends in agricultural output in the non-reservoir lands in these areas. Further reductions were effected by the disruptions associated with appraisal, negotiation, and purchase, and by the over-evaluation of risks of using reservoir lands, the inherent reluctance of farm operators to accord reservoir lands proper treatment, the absence of a positive land management policy, and some of the problems associated with the competitive bidding system in effect.

With minor restrictions and flexibility on the part of farm operators, reservoir lands could continue in use. This would mean locating farmsteads elsewhere and using these lands at some distance from the farmstead for crops, hay, or pasture in reorganized units and according to capabilities. With these projects, the affected areas were largely concerned with dairying. Had the areas been used for fruit or crops with less tolerance as to soil and water conditions, the residual effects would have been increased and the prospects for minimization reduced.

4. Minimizing the Adverse Effects of Flood Control Projects on Agriculture

Having measured the effects of four flood control projects, i.e., Franklin Falls, Blackwater, Surry Mountain, and MacDowell, on agriculture in the reservoir areas, adjusted for trends and ownership and management considerations, how can experiences with these projects contribute to minimizing the impacts of future projects? Further, how can present policies on these and other existing projects be modified to assure the best possible use of reservoir lands, consistent with the public interest and the needs for agricultural output now and in the future?

These issues are discussed in two phases, i.e., those dealing with the acquisition of lands and properties located in the damsite and reservoir areas (or borrow areas outside these areas), and those related to reservoir land use and management during and after project construction.

A. Acquisition Procedures and Problems

Land and properties were purchased in fee simple or by flowage easement on behalf of the federal government by the Corps of Engineers. Entire holdings were bought where uneconomic or inaccessible units of land remained above the take-line. Where the portion of the property above the take-line was of sufficient size to comprise an economic unit and the property was still accessible, so that economic value was not greatly impaired, only that portion of the property below the take-line was bought. A high proportion of the land purchases involved sub-division, or severance of a portion of the owner's holdings.

Much of the land acquired was in occupied farms and residential uses when bought. The occupied properties were vacated when the government took possession and all buildings located below the take-line removed or demolished. Subsequently, the land was made available under leasing arrangements to former owners or neighboring farmers for agricultural uses.

Legal Basis for Acquisition

The real estate in the project areas was acquired under the right of eminent domain, which is the right of the government to take private property for a public use by making "just compensation" therefor. The "just compensation" required by the Constitution is the full and perfect equivalent for the property taken — the owner is entitled to receive the value of what he has been deprived of, and no more.

The United States Supreme Court has held that "the value of property results from the use to which it is put, and varies with the profitableness of that use, present and prospective, actual and anticipated. There is no pecuniary value outside of that which results from such use." Except under unusual circumstances, use values are assumed to be reflected in market values. Interpretation of the market value concept rests largely with the particular court under whose jurisdiction a land valuation proceeding comes, and the weight given to witnesses' testimony. By typical legal definition,

"market value is the highest price in terms of money which land will bring when exposed for sale in the open market, with a reasonable time allowed to find a purchaser, buying with a full knowledge of all uses and purposes, to which it is adapted, and for which it is capable of being used."[1]

Appraisal Procedure of the Corps of Engineers

Land appraisers were employed to make the basic evaluation of the reservoir lands and other lands required by the projects, and to estimate the damages caused by the taking of these lands from their private owners. After the area was surveyed to establish the take-line, the basic appraisal was made to provide evidence and expert opinion concerning the physical characteristics and value of the land, the crops, the timber, and the buildings and improvements. In the cases that involved severance, or the taking of only a part of the property, an appraisal was made of the worth or market value of the remaining property to an average user. The difference between the market value of the established unit and that of the unit remaining after the severance was considered to be the warranted purchase price, including damages caused by the taking of part of the unit.

With this background, the owner was contacted to determine his asking or demand price. If the owner's price did not exceed the appraised value, the purchase was negotiated at the owner's price. If the owner's price exceeded the appraisal value, the appraisal was reviewed with the owner to determine the differences between the two evaluations. If the differences were not great, or if the owner's evaluation included elements of value not covered by the original appraisal — such as prospective mineral development or anticipated development of camp sites — the case was referred back to the appraiser for reappraisal. If the differences were great, a second appraisal was made by a different government appraiser. In the event the second appraisal was in substantial agreement with the owner's evaluation, or if the owner was willing to accept it as the basis for settlement, the deal was closed on that basis.

If the second appraisal confirmed the first and the owner was still unwilling to settle at approximately the appraisal value, a local appraiser was employed to make a third appraisal. If the owner would not sell for approximately the highest of the three appraised values, the case was referred to court for settlement.

As a matter of general practice, the Corps accepted the owner's price, if it did not exceed the appraisal value by more than 10 percent. This was assumed to be the maximum cost that could be avoided by immediate settlement. The cost clearly avoidable was the cost of another appraisal until the third appraisal was made. After the third appraisal, the cost clearly avoidable was that of court proceedings.

Appraisal, Negotiation, and Settlement; Their Adequacy and Equity

Appraisal reports were submitted in summary form so exact procedures used by appraisers in arriving at evaluations of project properties are not clear. However, land in each ownership unit was classified and valued on the basis of judgment as to best apparent use. Improvements were listed,

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[1] (10 Calif. Jur. Sec. 54, p. 338.)

described, and valued separately according to the appraiser's estimate of their worth to an average farmer, rural resident, or other local user. It is not clear that more than incidental attention was given in the basic appraisal to specific uses being made of the property, or to the owner's current net earnings from the property. The apparent purpose was to estimate market value under conditions of optimum use and management.

Despite the limited amounts of certain types of information contained in appraisal records, property owners, by and large, received a reasonable "market value" for their holdings. Viewing the tracts in total (Table 18), it is apparent that appraiser's classifications of land were liberal, in keeping with the legal concept of potential rather than actual use being made of these lands. Table 19 summarizes a few pertinent facts relative to real estate purchases for the Franklin Falls, Blackwater, and Surry Mountain projects. Of particular significance is the fact that the aggregate purchase price for tracts containing 10 acres or more of farm land did not vary more than 10 percent from the appraised value.

However, these totals can obscure any individual cases in which greater relative differences existed. As one might suspect from the Surry Mountain totals, many settlements were concluded on the basis of the owners' asking prices which were below the appraisal valuations. Such imperfect knowledge on the part of the seller probably should not be exploited when undertaking public acquisition of private holdings. Much may be lost in terms of public relations. Perhaps the initial appraisal valuation should be disclosed to each owner, or tendered as an initial offer, eliminating the seeking of an intial asking price.

Table 18. Uses of Land in Four Reservoir Areas Prior to Acquisition, Appraisal Classifications and Actual

Res. Area	Total	Cropland[1]	Pasture	Woodland	Other
	(acres)	(acres)	(acres)	(acres)	(acres)
Appraiser's classifications:					
Franklin Falls	3,810.46	926.18	361.05	1,460.54	1,062.69
Blackwater	3,553.09	529.80	331.80	2,517.60	173.89
Edward MacDowell	1,327.00	—	—	—	—
Surry Mountain	1,754.30[2]	519.69	425.37	760.16	49.08
Estimated land use for agriculture:[3]					
Franklin Falls		378.35	1,050.40[4]	—	—
Blackwater		249.70	703.80[4]	—	—
Edward MacDowell		69.56	44.00[4]	—	—
Surry Mountain		402.70	640.90[4]	—	—

[1] Cultivated crops and hayland.

[2] Includes 23 acres of cropland subsequently sold back into private ownership, 17.71 acres held under flowage easements, and 1.44 acres paid for by N. H. Highway Department, as used in the relocated highway.

[3] As developed under section 2.a., this report.

[4] Includes brush pasture and woodland pastured.

In any situation where private holdings are acquired under the rights of eminent domain, feelings against this invasion of the established order can run high. However, time has a way of softening these feelings, especially if most people become convinced that just compensation has been received. But a number of individuals involved with the projects under study, either

Table 19. Purchases of Real Estate for the Franklin Falls, Blackwater, and Surry Mountain Flood Control Reservoirs[1]

Item	Unit	Franklin Falls Reservoir	Blackwater Reservoir	Surry Mountain Reservoir
Total acquired				
Tract[2]	number	318	128	66
Land area	acres	3,811	3,553	1,754
Purchase price[3]	dollars	942,565	136,335	127,437
Size of tracts				
Less than 1 acre	number	142	10	9
Over 1 acre but less than 10 acres	number	89	42	25
10 acres or more	number	87	76	32
Classes of Land acquired[4]				
Cropland[5]	acres	1,026	530	520
Pasture[6]	acres	371	332	425
Woodland	acres	1,782	2,518	760
River channel and streambank	acres	391	153	49
Other (city lots, camp sites, roads, etc.)	acres	241	20	
Tracts containing cropland or pasture	number	90	47	47
Tracts containing 10 acres or more of farm land	number	44	20	26
Total area	acres	2,601	1,284	1,356
Cropland[5]	acres	1,006	434	479
Pasture[6]	acres	364	309	395
Purchase price[7]	dollars	288,887	45,698	93,893
Appraised value[8]	dollars	261,595	32,146	95,802
Land	dollars	107,055	27,606	—
Improvements	dollars	154,540	14,540	—

[1] Compiled by the U. S. Dept. of Agriculture, Agricultural Research Service, Production Economics Research Branch, and N. H. Agricultural Experiment Station, from land appraisal and land acquisition records of the Corps of Engineers, U. S. Army.

[2] In some instances, two or more parcels in the same ownership were appraised together.

[3] Includes severance damages and deficiency and interest payments on real estate acquired by condemnation. Does not include $14,695 paid for removal of bodies from seven cemeteries. Does not include $94,055 paid for town and public service properties that did not involve fee-simple real estate.

[4] As classified by the land appraisers.

[5] Plowable land (used for crops, hay, rotation pasture or idle).

[6] Non-plowable, or stony, brushy and woodland pasture.

[7] Includes deficiences and interest payments allowed by courts in condemnation cases.

[8] Includes the appraisers' estimates of reasonable severance damages in cases involving parcelization.

as former owners or local officials, still deplore the lack of explanation of procedures and plans and of local participation during the course of acquisition. Their feelings are that efforts to reach all those affected were less than desirable. While not questioning the integrity of individuals involved, they point out that the appraisers were on the Corps' payroll and that there was very little local representation involving individuals not connected with the action agency.

Probably many misunderstandings arise inadvertantly, but the reactions of people to the New Hampshire projects seem to parallel those observed in similar situations in other states. Some of the remedies suggested for other areas are equally applicable to local conditions. In studying the local effects of the Wappapello Reservoir (Missouri)[1] to find ways of lessening undesirable effects of reservoirs, it was recommended that (1) greater cooperation exist between the federal, state and local governments relative to informing the public more fully about plans for a reservoir and local effects which can be expected, (2) advisory committees of local citizens be established to facilitate necessary local adjustments, and (3) explanation of appraisal methods and appraisal values be provided property owners. Relative to the New Hampshire projects under study, a recommendation made in another study[2] that, "Local people should be organized so as to enable them to work effectively with federal agencies", might, if carried out, enable the increased cooperation and local participation so many indicate as desirable and necessary. These reports stressed the necessity for prompt payment for the land to give the landowner an opportunity to look for another farm and to make a gradual transition.

In the case of the New Hampshire projects, it was pointed out that the most noticeable impacts were short run in nature. Hence, with respect to future projects in this area, increased emphasis should be placed upon the lessening of these. This included measures to facilitate an orderly transition, preferably over a period of years, as well as broadening the concept of just compensation to include compensation for determinate costs of moving from the area.

The Tennessee Valley Authority included a relocation program carried on by the Extension Service in cooperation with TVA, and "fair market" value was interpreted to mean the price required to leave the landowner in the same financial position after as before the taking of his property.[3] The Wappapello study recommended that consideration be given to the cost to an owner of purchasing comparable property when appraising the value of his property.[4]

One point called to attention was the claimed inequity of the acquisition of certain tracts of forest and woodland at present "market value". Former

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[1] "Local Effects of the Wappapello Reservoir, Wayne County, Missouri, with Suggestions for Lessening Undesirable Effects of Reservoirs," Missouri Division of Resources and Development, Jefferson City, Missouri, February, 1950, p. i.

[2] "Reducing Adverse Effects of Reservoirs," Great Plains Council Pub. No. 6, Kansas Agr. Exp. Sta. Circ. 293, October, 1952, p. 4.

[3] "TVA Land Acquisition Experience Applied to Dams in the Missouri Basin," Great Plains Council Pub. No. 9, South Dakota Agr. Exp. Sta. Bul. 432, August, 1953, p. 42-43.

[4] "Reducing Adverse Effects of Reservoirs," Great Plains Council Pub. No. 6, Kansas Agr. Exp. Sta. Circ. 293, October, 1952, p. 4.

owners offered no solution to this problem, but pointed out that they had bought these properties with a view to their long-range appreciation in value, and that such appreciation now accrued to a federal or state agency. They felt that acquisition had deprived them of this future income which they had preferred to seek in such fashion rather than through other alternatives.

Perhaps in view of the findings of this study, and of other studies in other areas, the short-run impacts on agricultural units can be minimized through closer cooperation between federal, state, and local governments and the individual landowners involved with future projects, and certain adjustments in procedures and interpretations. Certainly improved public reaction should result without any lessening in long-range benefit.

Alternatives to Outright Purchase and Continued Federal Ownership and Management of Reservoir Lands

Principal alternatives are: (1) use of easements in place of fee simple purchases, (2) reselling lands back into private ownership by the government, and (3) assignment of management rights, subject to prescribed conditions, to state agencies or private individuals. All three have been used to some extent on the projects studied.

With easements, title to the property remains vested in the private owner, with the government acquiring the right to flood the land in connection with operation of the dam. Where used in the study situations, flowage involved only a minor portion of a holding. This method could give rise to adverse public relations because of damage claims based on alleged misrepresentation or lack of prior information on flooding.

Selling lands back into private ownership would appear feasible only if such lands were entirely above the flow-line, or if the government retained an easement or ownership to those portions subject to inundation. This method is essentially similar to purchase of easements with the added advantage that such lands could be regrouped into more economical units prior to resale.

Both former owners of timber and woodland tracts and private firms have displayed interest in stands developing on reservoir lands. To date, these have not been let out to private enterprise. In the Blackwater area, the State Forestry Department has undertaken management of certain nonagricultural tracts. Many tracts in the reservoir areas are now relatively inaccessible. To protect its dam and pool areas from excessive debris, the Corps might also require clean-cutting and brush removal. This might prove costly to operators.

It is doubtful if use of easements or resale of land into private ownership would materially enhance optimum use and management of reservoir lands. Possibly influence toward such an objective could be exerted by added conditions involving performance of certain measures to maintain productivity and use of such lands according to capabilities.

Compensating Towns for Loss of Tax Base

Acquisition of substantial holdings for establishment of a flood control project may have a considerable impact upon taxable valuation in particular towns. Because of the importance of the property tax as a local source of

revenue, this would increase the tax burden on remaining properties. Similarly, acquisition of town properties at anything less than replacement cost would contribute to a further increase in property taxes if the town replaced them. Indirect effects on town operating costs are difficult to appraise. On the one hand, services to the reservoir area would be eliminated. On the other hand, existing services, such as school bus routes, might be increased in scope to go around the reservoir area.

Typical of the present realization of the need for aid to towns affected by flood control projects is the following action recommended to the 1955 session of the New Hampshire General Court:

"On or before the first day of October of each year, the State Treasurer shall pay to each town and city in which any land or interest is acquired hereunder by the United States a sum equal to the taxes which would have been assessed against said lands or interest therein in such town if the same had been included in the list of taxable property for such year, at the assessed valuation of the same as determined for the tax year 1939, for a period of eighteen years next ensuing the year said lands or interest therein become exempt from taxation, less any amount paid or due that town for that year by or from the United States or any agency thereof because of loss of taxable valuation. . ."[1]

In the same report[2] a draft of an act authorizing an interstate compact for flood control on the Merrimack River recommended that:

"Article V — The Commonwealth of Massachusetts agrees to reimburse the State of New Hampshire seventy percent of the amount of taxes lost (to its political sub-divisions) by reason of acquisition and ownership by the United States of lands, rights or other property therein for the flood control dams and reservoirs at Franklin Falls, Blackwater and West Peterborough, and for construction in the future of any flood control dam and reservoir specified in Article IV, and also for any other flood control dam and reservoir hereafter constructed by the United States in the Merrimack River Valley. . ."

Flood control compacts are subject to ratification in Congress after the state legislatures approve them. In the Connecticut River Basin, New Hampshire has entered into compact with Vermont, Massachusetts, and Connecticut. New Hampshire tax losses resulting from ownership or future land acquisition for flood control by the federal government would be reimbursed by Massachusetts, at 50 percent and by Connecticut, at 40 percent. Payment is for non-speculative economic losses.[3]

These acts show recognition of the need for reimbursing towns for loss of the taxable base, and also that such reimbursement should be shared by all states benefiting from such flood control projects. These measures go a long way toward meeting the standard that the government should avoid impairment of the finances of state and local governments when it acquires land for reservoir use.[4] The closer to offsetting the reduction in taxes and

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[1] "An Act Relative to Reimbursement of Towns and Cities for Land Taken by The United States for Flood Control". Report to the 1955 session of the General Court by the Legislative Council and the Timber Tax Study Committee, State of New Hampshire, submitted December, 1954, p. 127-128.

[2] Ibid, p. 106.

[3] New Hampshire Water, op. cit., p. 6.

[4] Kansas Agr. Exp. Sta. Circ. 293, op. cit., p. 4.

operating costs that reimbursement policies can come, the better will be the position of remaining farm operators, who will in all probability use the reservoir lands in the post-construction period.

B. Devising an Improved Land Management Policy

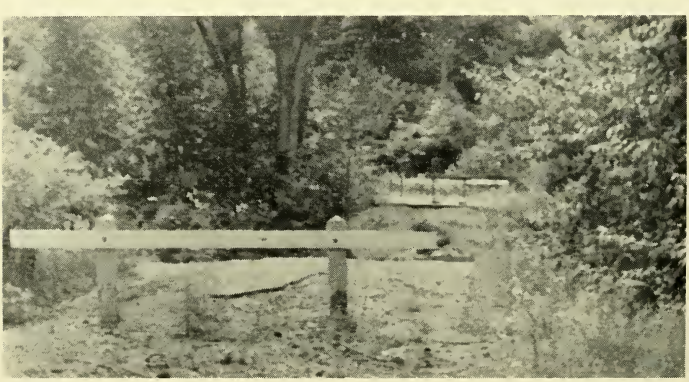
With the four projects studied, the acquisition phase has been long accomplished, and the passage of time has removed much of the original agricultural land from practical participation in any new programs without heavy reclaiming costs. Hence, the possibilities for future accomplishment through improved land management policies are relatively more limited than would be possible on future projects, and the importance and magnitude to the four projects of certain suggestions is greatly reduced.

Obviously, what can be done in maximizing post-construction agricultural output will be affected by the type of project, i.e., whether designed solely for flood control purposes, with the reservoir area normally empty during the growing season; or whether designed as a dual-purpose project involving, in addition to flood control, power or recreational uses. The four projects studied were designed essentially for flood control, though Blackwater represents a potential power site and Surry Mountain has been considered for recreational use.

As alternatives to maximum use of reservoir lands for agricultural purposes must be considered the use of portions of such lands for recreational and reforestation purposes. This study was not designed to evaluate these substitute uses. In effect, however, forest and woodland growth has encroached on former agricultural lands where these were not kept in that use.

Retaining Accessibility

Discontinuance of pre-construction public and private roads, removal or abandonment of bridges, and the failure to construct and maintain access



A covered bridge formerly spanned the Blackwater River at this point. Inaccessibility is one deterrent to greater use of reservoir lands.

This area behind Surry Mountain dam formerly was hayland and pasture. It is now cleared of buildings, trees, and bushes, but little used. It could furnish seasonal pasture.

roads has led to the abandonment, under-utilization, and eventual unavailability of agricultural lands. Some tracts can still be used if made more accessible. With future projects, a network of access roads (for agricultural, fire-prevention, recreational, and woodland-forest management use) needs to be planned and built as an integral part of the project. Such a network would also be essential to implement an effective warning service to lessees. Corps' personnel at the four projects studied have done an outstanding job in keeping lessees informed about possible flooding conditions.

Using Lands in Accordance with Their Capabilities

Early in the program, land should be classified as to its most desirable use, both for agriculture and other purposes. Tracts should be laid out which can be operated efficiently. Expectations of frequency, duration, depth, and season of inundation should be considered as an integral part of capability analysis. Here, there is need to recognize that mere inundation does not preclude land from agricultural use and a pressing need to so convince prospective users. The record of users in the four projects studied shows only minor damage to crops and hayland over the period since project construction. In most instances, these were associated with tracts which were adaptable only for pasture. Hence, risks are greatly over-exaggerated and thus far there have been no major floods during the growing season. (See Tables 2 through 5.)

In connection with the adaptability of reservoir lands for agricultural use there is need for specific information under local conditions on the tolerance of various crops and forage to inundation for different stages in development, as well as the effect of duration and depth. McKenzie and

other workers[1] have considered this problem. For example, McKenzie summarized the ability of forage plants to survive early spring flooding for different stages of development. Relationships between species were fairly constant in seed, seedling, and mature plant stages. He found that grasses endured better than legumes. Mature plants endured inundation for various periods from 7 to 63 days without excessive permanent injury.

In the post-construction period, reservoir lands have been extensively used for pasture for young stock and dry cows. Reservoir pasture can also be effectively used for pasture for milking animals, with adjustments to permit milking in the pasture. Certain operators in the Franklin Falls area have been able to devise methods for doing this. In calculating the carrying capacity of reservoir pasture, season-equivalents were derived. There is no reason, however, why reservoir pasture cannot be worked into a pasture rotation program, particularly for nearby operators.

Modifying Methods and Conditions of Leasing Reservoir Lands for Agricultural Use

With the shift of reservoir lands from private to public ownership, farm operators were afforded the opportunity to secure five-year leases on tracts largely of their own selection through competitive bidding. Many have taken advantage of this opportunity. Yet, with many of these operators, there is great reluctance to make full use of leased reservoir lands. Some operators

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[1]McKenzie, R. E., "The Ability of Forage Plants to Survive Early Spring Flooding," Sc. Agric. No. 31, 1951, p. 358-367.

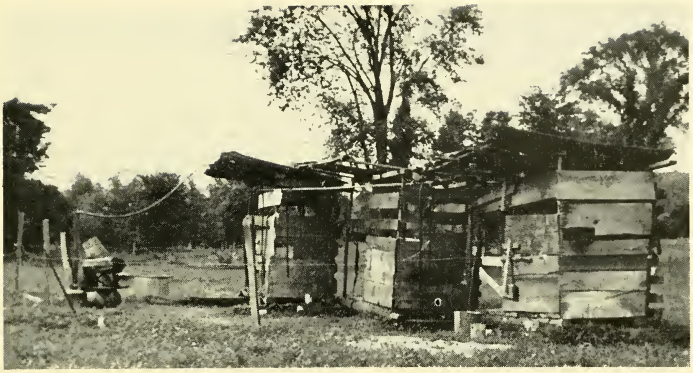
Bolton, J. L. and R. E. McKenzie, "The Effects of Early Spring Flooding on Certain Forage Crops," Sc. Agric. No. 26; No. 3, March, 1946, p. 99-105.

McKenzie, R. E. "The Effect of Flooding on Emergence of Forage Crop Seeds," Sc. Agric. No. 29, 1949, p. 237-240.

Davis, A. G., and Betty F. Martin, "Observation on the Effect of Artificial Flooding on Certain Herbage Plants," J. British Grassland Society 4:1, 1949.

Reynteus, H., Research about the resistance to flooding of different species of grasses and clovers and the value of the botantical composition of the grass flora in the periodical overflowed areas of the valleys of the rivers Dender, Durme, and Schelde, Deel XIV, Nr. 3, September, 1939.

The area behind Edward MacDowell dam is now used largely as a waterfowl sanctuary by the New Hampshire Fish and Game Department.



Yankee ingenuity at work: summer milking stalls on leased pasture land in Franklin Falls resevoir. Note legume-grass seeding in foreground.

accord these lands residual treatment, others use these lands in a similar fashion to those they own, either at a low or high level of management. Competitive bidding of itself does not assure that the best operators will receive the leases. Contractual specifications do not assure that the lands be used for the best purpose or that the productive capacity of the lands will be maintained.

The matter of insecurity of leases is of real concern. Many operators point out that it will take them most of the five-year lease period to restore the land on a run-down tract to a higher level of productivity. At that time, they risk losing the lease to someone else who will reap most of the benefits of their work and investment. There are a number of cases where this has happened. The reverse has also happened. i.e., a poor operator has lost a lease to a better one; but here, the better operator can risk rebuilding the productivity with the distinct possibility of losing it in five years. One alternative is leases running for more than five years, thus permitting more year's output at the restored level. In reverse, however, this could also give the poorer operator a longer time in which to mine the soil fertility, let the brush grow up and destroy the desirable cover. Hence, the best answer probably does not lie in longer leases, per se.

The studied recommendations of other reports relative to leasing and post-construction land management have application to the findings of this study. One study recommended the following:[1]

"Minimize disturbance by leasing to current owner-operators and tenants wherever practical, using leases which are renewable as long as their provisions are carried out.

"Discontinue preferential leases to former owners who have no intention of operating the land themselves.

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[1] Local Effects of the Wappapello Reservoir, op. cit., p. iv.

"Discontinue leasing agricultural land on the basis of highest sealed bids.

"Employ a qualified land manager to handle the agricultural land and negotiate agricultural leases."

In discussing these matters, it is assumed that the lands are purchased and retained under government ownership and/or management. Under such arrangements, former owners might well continue to receive some preferential treatment so long as they meet prescribed standards relative to land use and management. To implement this, the administering agency should have the right to terminate a lease for non-compliance at the end of any growing season. Leases should come up for renewal periodically, but a lessee who has done a good job should have the opportunity to meet the highest bid of another good operator. Thus bidding would not be eliminated but merely subordinated to other more important considerations.

One of the problems to be solved in securing more widespread and better use of reservoir lands is the spread of information on actual risks. In addition, there may be room for a limited program of insuring against risks, according to location and use, by a small charge, either voluntary and in addition to the rental charge, or compulsory and incorporated within it.

The policies of the Corps to date have not resulted in maximum use of reservoir lands suitable for agriculture, nor in the maintenance of such lands in a high state of productivity for future needs. There is need for additional resources, within the Corps' organization, or by delegation to another agency closely connected by its basic responsibilities to land use and conservation aims, in the form of personnel and equipment to carry out a more active land management program.

Appendix I

Techniques and Sources of Data for Determining Pre- and Post-Construction Agricultural Output from Reservoir Areas

Soil Capabilities Classes

The productivity of the land in the site can be rated according to its best usage in terms of soil type, slope, and erosion. (See Appendix Table I.) Output can then be derived under prevailing and optimum management conditions. (See Appendix Tables IV and V.)

Estimates of this type were derived for the present (pre-construction) period in an analysis of the effects of the proposed Hopkinton-Everett project on agriculture. In this particular study, it was indicated that no attempt was made to estimate the value of production in the reservoir site during the post-construction period under either prevailing or optimum management conditions. The report indicated such a determination would require reliable predictions of the frequency, depth, and duration of inundation; the character and size of farms immediately surrounding the site; and the responses of farm operators and management policies.[1]

The principal drawbacks to deriving estimates from soil capability classes are as follows:

(a) If the technique is applied in an aggregative sense to all the land, ownership boundaries are ignored.

(b) Use of average yields will not allow for management variations from farm-to-farm.

(c) Results for the individual units might be impractical if individual fields were parcelized into a number of capability classes.

(d) Soil capability data is not available for all the existing and potential reservoir areas. Hence, until such information became available, the technique could not be used universally.

(e) Goals established strictly from the conservation approach are not necessarily the same as would be derived from the totals of unit planning wherein maximization of producer returns and/or reductions in food costs to consumers are reflected.

(f) Soil capability data are most useful in planning programs for existing or potential reservoir areas. Together with photointerpretation data and data on the expectations of flooding and a pattern of land use consistent with the requirements of efficient farm enterprises in the area, such data can become the basis of management policies. However, soil capability data of itself does not directly involve specification of land use and/or type of cover.

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[1] "Social and Economic Impacts, Proposed Hopkinton-Everett Reservoir, Merrimack River Basin, New Hampshire," edited and published by Planning Division, N. H. State Planning and Development Commission, March, 1955, p. 17-18; Appendix II, table K.

(g) Land-use capability data, without supplementary information on the livestock numbers or on crops grown, does not yield a wholly accurate measure of output.

Photointerpretation

Using the technique of photointerpretation[1] it is possible to derive data on the areas involved in an extensive list of uses. If photos from aerial flights made at different periods are available, a measure of change can be obtained. Photointerpretation has the advantage of attempting to recognize and label open areas which logically represent potential areas of principal output of crops, hay, and pasture. It also ties into use at a specified point of time, and where the grid-count technique rather than the planimeter is used, more accurately adjusts area totals for land in roads, farmsteads, water, etc., which land cannot be considered for potential agricultural output at that point of time.

Some of the drawbacks to the use of photointerpretation results are as follows:

(a) Without a supplementary survey, ownership boundaries are not considered.

(b) Under the usual approach, translation to output would require use of some assumed average yields and treatments.

(c) The combination of photointerpretation with land-use capability data will produce a more accurate estimate of "potential" or "optimum" output, but needs to be supplemented by other types of information to maximize its value in planning post-construction land management policies.

(d) There are likely to be some errors in the interpretation of use classes, particularly between permanent pasture, run-out hayland, idle farmland, and urban open areas.

(e) Photointerpretation cannot be too precise as to the actual crops grown and further does not reflect livestock numbers nor the crop-livestock balance.

Appendix Table II shows the estimated land use in the four reservoir areas under study, using 1952 and 1953 flights.

When certain of these data are compared with "actual" estimates of post-construction land use, the two sets of data are at considerable variance. One might expect slight differences between individual years and patterns typical of the post-construction period. Too, acreage values may be more closely controlled through photointerpretation than by using operator's or field observor's acreage estimates to subdivide leased acreage into components.

The cropland group under photointerpretation includes plowed land, row crops, and small grains. Under actual estimates, it is confined to cultivated crops, with hay or pasture seedings or rotation small grains being considered part of hay or pasture acreage. Hence, it is possible to visualize some discrepancies in the two sets of data from this source. Definitions of

[1] The methodology of applying this technique is discussed in an article by H. W. Dill, Jr., "Photo Interpretation in Flood Control Appraisal."

"open" and "brush" pasture can, by slight variation, result in sizeable acreages being shifted one way or the other. (See Appendix Table III.)

Appraisal Records

In the course of acquiring property for dam and reservoir sites, qualified appraisers were employed. Their reports included property descriptions and a classification of acreages into such categories as cropland, open pasture, brush pasture, and woodland. Appraisal data roughly parallels that obtained by photointerpretation with two exceptions. The latter does not yield information on ownership boundaries nor does it carry the validity of having been accomplished by an on-the-ground survey of the area under question.

Some of the drawbacks to the use of appraisal records are as follows:

(a) Translation to output would require use of some assumed average yields and treatments.

(b) Appraisal records are not specific as to whether properties were actually used in all cases in accordance with land classifications. Data are known to include idle land.

(c) Appraisal records are not precise as to actual crops grown nor do they reflect livestock numbers and the crop-livestock balance.

(d) In many instances, land may be classified in a higher use than warranted by its capability or than was being made of it at the time of acquisition.

(e) Property valuations agreed upon for settlement, and the distribution of these between land and buildings, and to a lesser extent, appraisal valuations themselves, were influenced by some factors not necessarily related to output. Some of these were the length and cost of negotiations, owner's ideas of valuations, location of the property.

Table 18 summarizes the land use in the four reservoir areas, as indicated by the land classifications assigned by appraisers. For comparative purposes, the estimated actual pre-construction use of land for crops and pasture is also shown. Appraiser's figures seem to overstate cropland and understate pasture. They also included under woodland some areas which furnished some grazing, however slight.

Budgetary Analysis

One technique used effectively in farm management research and application is that of complete or partial budgeting. With this approach, "typical" units are usually selected and appraised in terms of "before" and "after" application of a particular technique or program. Net effects can be expressed in terms of physical units, but are more typically expressed in terms of net effects on income.

Parsons, in applying this technique to a proposed land treatment program for the New England-New York area, makes these pertinent observations:[1]

(a) "The degree to which a program may be carried out as well as the results attained from a program are dependent upon the unique circum-

[1] Parsons, M. S., "Farm Aspects of Conservation Development in New England-New York," prepared for the Agriculture Study and Report Group of the New England-New York Inter-Agency Committee, Bureau of Agricultural Economics, U.S.D.A., September, 1953, p. 2.

stances surrounding each individual case. Variation between farms of the region reflects a complex of factors including quality of land, management skill, size and type of farm, financial resources, and many others.

(b) An analysis centered around the operation of an individual farm reveals the nature and extent of adjustments in other phases of the farm organization that must go along with land improvements if full benefits are to be realized.

(c) The influence of a land treatment program upon costs of farm operation and on the resulting output and income can be estimated with a fair degree of accuracy for an individual farm situation. This is because the case approach permits more adequate consideration of such important factors as type and size of farm, quality of land, grade of management, degree of interest in farming, and stage of development of the farm in question." He feels that added insight which can be had by the unit approach as compared to the area approach, or the so-called benefit-cost analysis.[1]

To have employed the budgeting technique, in the usual sense, to the effects of flood control projects on the agriculture in reservoir areas, would have required the existence of somewhat comparable units both before and after construction. Since reservoir lands passed from private to public ownership and management, this condition was not satisfied. Furthermore, the difficulties of selecting "typical" units in a heterogeneous area would be great. With respect to reservoir areas, paramount interest rested on aggregate effects so other techniques offered greater promise in reaching this goal.

S. C. S. Farm Plans

Through the cooperation of district chairmen and individual farmers, farm plans were made available for study. These furnished much valuable information on a number of units. However, almost all were downstream farms rather than those using reservoir land. Furthermore, original and revised plans usually did not closely span the time period involved, and reservoir lands were not generally included. Had there been rather complete unit planning in the areas of the type accomplished by the S.C.S., and had the time interval been approximated, much valuable basic data could have been had without actual field surveys.

Types of Farming Maps

During the late 1930's and early 1940's, the New Hampshire Agricultural Experiment Station completed a map for each town in the state. These showed location of roads, rural residences, numbers of cows, numbers of hens, acres of fruit, vegetables, potatoes, and other data related to each unit's output. Such data contributed to studies of types of farming.[2]

Town maps of this nature, when checked against lists of names appearing in property acquisition records of the Corps of Engineers and when com-

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[1] The benefit-cost technique is described rather fully in: "Proposed Practices for Economic Analysis of River Basin Projects," prepared by the Subcommittee on Benefits and Costs, Report to the Federal Inter-Agency River Basin Committee, May, 1950.

[2] For example: Grinnell, H. C., "Type-of-Farming Areas in New Hampshire," N. H. Agricultural Experiment Station Circular 53, February, 1937; and Middaugh, W. S., and M. S. Parsons, "Type of Farming in the Northeast Region," Bureau of Agricultural Economics, U.S.D.A., June, 1946.

pared with maps delineating reservoir areas, furnished much working data relative to pre-construction output in the Franklin Falls, Blackwater, and Surry Mountain areas. For the MacDowell project, which was undertaken in the late 1940's, such town maps could not be used at all because of the great discrepancy in time periods.

Types of farming data contained no mention of the crop and pasture acreage associated with particular livestock numbers, nor its location. In some instances, units recorded elsewhere were omitted. Some producers, whose farmsteads were not physically located in areas which were subsequently acquired, used lands in those areas.

Livestock Numbers

Data are collected annually by selectmen of towns and appraisers in cities of New Hampshire in connection with tax listings. This information, by individual farms and taxpayers, was obtained for the pre-construction period and for 1953-1955, and supplemented data on types of farming maps and from other sources. Individual units could be located on maps, but again data on numbers of livestock furnished no estimate of acreages used or their locations.

Census Data

Another source of information, though not used in this study because of the costs and time required to obtain it, is Bureau of the Census reports on individual units. Such data would furnish relatively accurate measurements of pre-construction output in areas under consideration. It would be accurate as to livestock numbers, acres, forage production, and crop acreages and output for individual farm units.

However, such data would not be specific as to the location of the land involved, and would not necessarily be conclusive enough to enable determination of reservoir and non-reservoir lands. In the post-construction period, such a determination from Census data would be even more difficult due to the shift in ownership from private to public in reservoir areas.

Output Measurement on Future Projects

For future flood control projects, it would be possible to describe pre- and post-construction output from the reservoir lands, both for crops and for the livestock utilizing crops, by making farm-by-farm and tract-by-tract surveys. With existing projects, it is possible to use leasing records and maps of the Corps of Engineers, supplemented by data obtained from lessees, to describe with some accuracy, output from reservoir lands in the post-construction period. While some inaccuracies may be involved due to the passage of time and the fallibility of memory, such estimates are probably fairly accurate.

However, to now attempt to survey all former owners, or people who knew them, would be rather time-consuming. Some operators have moved from the area, many might have difficulty recalling accurately the required information. A number of operators have died. Hence, estimates for such tracts as they owned would be second-hand. In many instances, data secured by contacting former owners did not check out very well against recorded

sources such as types of farming maps or livestock numbers recorded for tax purposes.

Studies of the probable impacts of future projects should be based on farm-by-farm and tract-by-tract surveys. Gathering pre-construction data would require additional field resources on the part of the Corps of Engineers, the Department of Agriculture, the State Experiment Station, or some other designated agency. Inasmuch as it is already necessary to map the area under consideration when contemplating a particular project, and to have engineers and appraisers go over the area rather thoroughly, the inclusion of personnel specifically trained to appraise effects in economic and/or sociological terms might prove a sound investment. Valuable additional data would be available for use in appraising, valuing, and settling for lands and units acquired. Such data would contribute to the most exacting estimates possible of the effects of the project, not only on agriculture, but on other segments. With heterogeneous units, the added accuracy from surveying would undoubtedly be worth the extra effort required.

Synthesis

To derive estimates of actual pre- and post-construction agricultural output in reservoir areas, which form the basis for subsequent appraisals of the effects of particular flood control projects, it was necessary to use information from a number of sources. Such estimates, as previously noted, are approximations of the results which might have been obtained by on-the-spot current surveys.

For the post-construction period, the following types of data were used:

(a) Maps and leasing records of the Corps of Engineers, and discussions with Corps personnel.

(b) Interviews with as many present and former lessees as could be reached within the limits of time and personnel devoted to the study.

(c) Field notes obtained by a visit to all tracts presently or formerly leased.

(d) Aerial photographs.

For the pre-construction period, the following types of data were used:

(a) Maps and acquisition records of the Corps of Engineers, including land classifications of appraisers.

(b) Discussions with appraisers, former owners, and present and former town officials.

(c) Aerial photographs.

Appendix II

Supplementary Tables

Appendix Table I. Surry Mountain Reservoir: Use of Land at Time of Acquisition, By Use-Capability Classes[1]

Land use	Use-Capability Class							
	I	II	III	IV	VI	VII	VIII	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
Cropland[2]								
Row	97.10	42.53	—	—	—	3.88	—	143.51
Hay	327.30	18.52	8.00	23.00	—	—	—	376.82
Total	424.40	61.05	8.00	23.00	—	3.88	—	520.33
Pasture								
Open	107.00	6.00	—	51.50	5.00	1.06	—	170.56
Brush	12.40	44.31	1.00	83.29	40.00	72.81	1.00	254.81
Total	119.40	50.31	1.00	134.79	45.00	73.87	1.00	425.37
Woodland								
Pole	4.60	—	10.00	12.00	12.00	344.56	—	383.16
Sapling	24.54	8.63	3.30	32.89	28.54	274.85	—	372.75
Total	29.14	8.63	13.30	44.89	40.54	619.41	—	755.91
Residential	7.93	—	.66	—	—	—	—	8.59
Other uses	3.50	3.71	—	.28	—	10.79	—	18.28
Wasteland	1.52	—	—	—	—	1.05	21.36	24.38
Total	585.89	123.70	22.96	202.96	85.54	709.45	22.36	1,752.86

[1] From unpublished report: R. D. Davidson, "Agricultural Impacts of the Surry Mountain Reservoir," Prod. Econ. Res. Br., Agricultural Res. Service, U.S.D.A., 1954. See also Appendix Tables IV and V.

[2] In the use classification, distinction is made between lands used for row crops and for hay, but no attempt is made to identify the lands used for small grain. The photographs used were taken in September under conditions which made it difficult to recognize small grain stubble. Oats is the only small grain commonly grown in the area and it is usually grown as a nurse crop in reseeding the hay crops.

Appendix Table II. Photointerpretation of Land Use in Flood Control Reservoirs, New Hampshire[1]

Land Use[2]	Franklin Falls Reservoir		Blackwater Reservoir		Surry Mountain Reservoir		Edward MacDowell Reservoir		Total of Four Reservoirs	
	Acreage	Percent of total	Acreage	Percent of total	Acreage	Percent of total	Acreage	Percent of total	Acreage	Percent of total
Cropland	45	1.2	17	.5	—	—	—	—	62	.6
Hay	119	3.1	120	3.4	10	.6	—	—	249	2.4
Open pasture	239	6.3	41	1.2	492	28.4	6	.4	778	7.5
Brushy pasture	399	10.5	296	8.3	92	5.3	—	—	787	7.6
Idle cropland	381	10.0	29	.8	—	—	90	6.8	500	4.8
Forest	1,740	45.7	2,595	73.0	813	47.0	729	54.9	5,877	56.4
Swamp	—	—	289	8.1	—	—	245	18.5	534	5.1
Borrow and gravel pits	30	.8	34	1.0	60	3.5	38	2.9	162	1.5
Urban	42	1.1	—	—	7	.4	3	.2	52	.5
Roads	85	2.2	14	.4	4	.2	18	1.4	121	1.2
Powerline	28	.7	—	—	20	1.2	—	—	48	.5
Dam area	26	.7	17	.5	32	1.8	14[3]	1.0	89	.8
Riverwash	127	3.3	—	—	—	—	—	—	127	1.2
Water surface	550	14.4	101	2.8	201	11.6	184	13.9	1,036	9.9
Total[4]	3,811	100.0	3,553	100.0	1,731	100.0	1,327	100.0	10,422	100.0

[1] Source: U. S. Dept. of Agriculture, Agricultural Research Service.

[2] Based on aerial photointerpretation, Franklin Falls and Blackwater Reservoirs, USDA flights of 1953, Surry Mountain and Edward MacDowell Reservoirs, USDA flights of 1952.

[3] Includes 11 acres in spillway and canal.

[4] Land appraisal and land acquisition records of the Corps of Engineers, U. S. Army.

Appendix Table III. Uses of Land in Four Reservoir Areas in Recent Years (Post-Construction): Photointerpretation and Actual

Res. Area	Cropland[1]	Hay	Open Pasture	Brush Pasture	Idle Cropland
	(acres)	(acres)	(acres)	(acres)	(acres)
Photointerpretation[2]					
Franklin Falls	45.0	119.0	239.0	399.0	381.0
Blackwater	17.0	120.0	41.0	296.0	29.0
Edward MacDowell	—	—	6.0	—	90.0
Surry Mountain	—	10.0	492.0	92.0	—
Estimated land use for agriculture[3]					
Franklin Falls	9.5	171.0	349.2	263.4	—
Blackwater	6.4	132.3	133.1	71.7	—
Edward MacDowell	1.8	29.1	—	—	—
Surry Mountain	3.2	135.0	117.5	117.4	—

[1] For photointerpretation, include plowed land, row crops, and small grains. Under "Estimated use. . .," include only cultivated crops.

[2] Source: Appendix Table II.

[3] As developed under 2.a., this report.

Appendix Table IV. Surry Mountain Reservoir: Productivity Ratings and Recommended Land Use, By Use-Capability Sub-Groups[1]

Capability Sub-Group	Productivity Ratings[2]								Recommended Use and Rotation[3]				
	Corn		Oats				Woodland						
	Grain	Silage	Grain	Hay	Mixed Hay	Pasture	Kind	Quantity	Corn	Oats	Hay	Pasture	Woods
	Bushels	Tons	Bushels	Tons	Tons			B.F.	Years	Years	Years	Years	Years
I—5	40	9	35	1.5	1.5	5	—	—	3	1	1	—	—
I—6	60	16	40	3.0	2.5	3	—	—	2	1	1	—	—
II—E-5	35	8	30	1.3	1.3	5	—	—	1	1	1	—	—
II—W-7	—	12	35	2.0	2.0	2	—	—	1	1	2	—	—
III—E-5	30	7	30	1.2	1.2	6	—	—	1	1	2	—	—
III—S-1	25	6	30	1.5	1.5	8	—	—	2	1	3	—	—
IV—E-5	25	6	25	1.0	1.0	7	—	—	1	1	4	—	—
IV—W-1	—	—	30	2.0	2.0	2	—	—	—	1	5	—	—
IV—E-2	—	—	—	—	—	6	—	—	—	—	—	P	—
VI—W-1	—	—	—	—	—	2	—	—	—	—	—	P	—
VII—S-1	—	—	—	—	—	—	Pine	350	—	—	—	—	P
VII—S-2	—	—	—	—	—	—	Pine	400	—	—	—	—	P
VII—W-1	—	—	—	—	—	—	Hardwood	75	—	—	—	—	P
VII—E-2	—	—	—	—	—	—	Pine	400	—	—	—	—	P
VIII—W-1	—	—	—	—	—	—	—	—	—	—	—	—	—

[1] Preliminary. From unpublished report: R. D. Davidson, "Agricultural Impacts of the Surry Mountain Reservoir," Prod. Econ. Res. Br., Agr'l Res. Service, U.S.D.A., 1954.

[2] As developed in Soil Survey, Cheshire and Sullivan Counties, New Hampshire, U. S. Dept. of Agriculture in cooperation with Univ. of N. H. Agri. Exp. Sta., Series 1937, No. 23. The indicated yields are those commonly obtained with the use of superphosphate or mixed fertilizer and manure.

[3] Generalized recommendations of the Soil Conservation Service.

Appendix Table V. Surry Mountain Reservoir: Recommended Use and Estimated Potential Annual Production of Acquired Land[1]

Capability Sub-Group	Total Area	Recommended Use					Estimated Annual Production				
		Corn	Oats	Hay	Pasture	Woods	Corn	Oats	Hay	Pasture	Woods
	Acres	Acres	Acres	Acres	Acres	Acres	Bushels	Bushels	Tons	A.U.M.[2]	B.F.
I—5	71.73	43.03	14.35	14.35	—	—	1,721.20	502.25	21.52	—	—
I—6	514.16	257.08	128.54	128.54	—	—	15,424.80	5,141.60	321.35	—	—
II—E-5	42.29	14.10	14.10	14.09	—	—	493.50	423.00	18.32	—	—
II—W-7	81.41	20.35	20.35	40.71	—	—	915.00	712.25	81.42	—	—
III—E-5	10.00	2.50	2.50	5.00	—	—	75.00	75.00	6.00	—	—
III—S 1	12.96	4.32	2.16	6.48	—	—	108.00	64.80	9.72	—	—
IV—E-5	38.33	6.39	6.39	25.55	—	—	159.75	159.75	25.52	—	—
IV—W-1	163.63	—	27.44	137.19	—	—	—	823.20	274.38	—	—
VI—E-2	8.54	—	—	—	8.54	—	—	—	—	7.1	—
VI—W-1	77.00	—	—	—	77.00	—	—	—	—	192.5	—
VII—S-1	158.61	—	—	—	—	158.61	—	—	—	—	55,513
VII—S-2	479.90	—	—	—	—	379.90	—	—	—	—	191,960
VII—W-1	46.09	—	—	—	—	46.09	—	—	—	—	3,457
VII—E-2	24.85	—	—	—	—	24.85	—	—	—	—	9,940
VIII—W-1	22.36	—	—	—	—	—	—	—	—	—	—
Total	1,752.86	347.77	215.83	371.91	85.54	709.45	18,897.25	7,901.85	758.26	199.6	260,870

[1] Based on Table 2 and Appendix Table I. From unpublished report: R. D. Davidson, "Agricultural Impacts of the Surry Mountain Reservoir," Prod. Econ. Res. Br., Agr'l. Res. Service, U.S.D.A., 1954.

[2] A.U.M. — Animal Unit Months.

Appendix Table VI. Outleases in Franklin Falls and Blackwater Reservoirs 1943-1955[1]

	Franklin Falls		Blackwater	
	Acres	Dollars	Acres	Dollars
1943	142	112	96	58
1944	316	200	191	128
1945	507	386	209	99
1946	584	552	304	145
1947	594	652	344	195
1948	608	656	377	200
1949	782	696	308	143
1950	751	739	306	178
1951	813	694	306	189
1952	751	701	317	195
1953	721	738	327	213
1954	703	735	317	212
1955	713	711	327	212

[1] From records of Corps of Engineers.

Appendix Table VII. Annual Man Hours per Head and per Acre and Conversion of Crop Inputs to Animal Unit Equivalents[1]

Unit		Man Hours Per Year
Per cow		
	Total per year	100
	Pasture season	40
	Barn-feeding season	60
Per head of youngstock		
	Total per year	30
	Pasture season	12
	Barn-feeding season	18
Per sheep		
	Total per year	5
	Pasture season	2
	Barn-feeding season	3
Hay, per acre		7-11
Open pasture, per acre		1- 2.5
Brush pasture, per acre		0.2
Corn silage, yield 8-10 tons per acre		18
Corn silage, yield 11-15 tons per acre		22
Corn silage, yield 16-20 tons per acre		26
Orchard, per acre		150
Home garden, per acre		250
Commercial vegetables, per acre		250
Small fruits, per acre		200
Potatoes, per acre		60
Hens, per 100		100
Pullets raised, per 100		25
Broilers raised, per 100		7.5

[1] Outputs of roughage and forage are expressed as tons of silage or hay and animal units grazed (mature cow equivalents). Head equivalents for livestock species involve summations based upon the carrying capacity of roughage and forage output, full-season pasturage being included at the rate of 0.4 unit, and roughage output (silage and hay) at the rate of 0.6 unit. Consumption of hay (alone) was estimated at 3.0 tons per cow, 4.0 tons per horse, 1½ tons per head of youngstock, and 700 lbs. per head of sheep. 3.3 tons of silage were considered equivalent to one ton of hay. Carrying capacity of pasture varied with condition, but on pastures of equivalent quality — one cow or one horse per X acres — it was estimated 1.33 head of youngstock or 5.0 sheep could be carried. Brush and woodland pasture was generally valued at the rate of 10 acres per cow or horse, 7 acres per head of youngstock, and 2 acres per sheep; open improved pasture at the rate of 3 acres per cow and 2 acres per head of youngstock; improved pasture, pre-construction, 1.5 and 1.0, respectively; and improved pasture, post-construction, 1.0 and 0.7, respectively. Variations from these occurred under some circumstances. Hay and silage yields per acre were variable, but were translated from tons to animal units by using consumption rates previously given.

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no.426-450
DATE DUE

NOV 4 '64	
MAY 19 '65	
Sept 24	
OCT 23 '68	
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